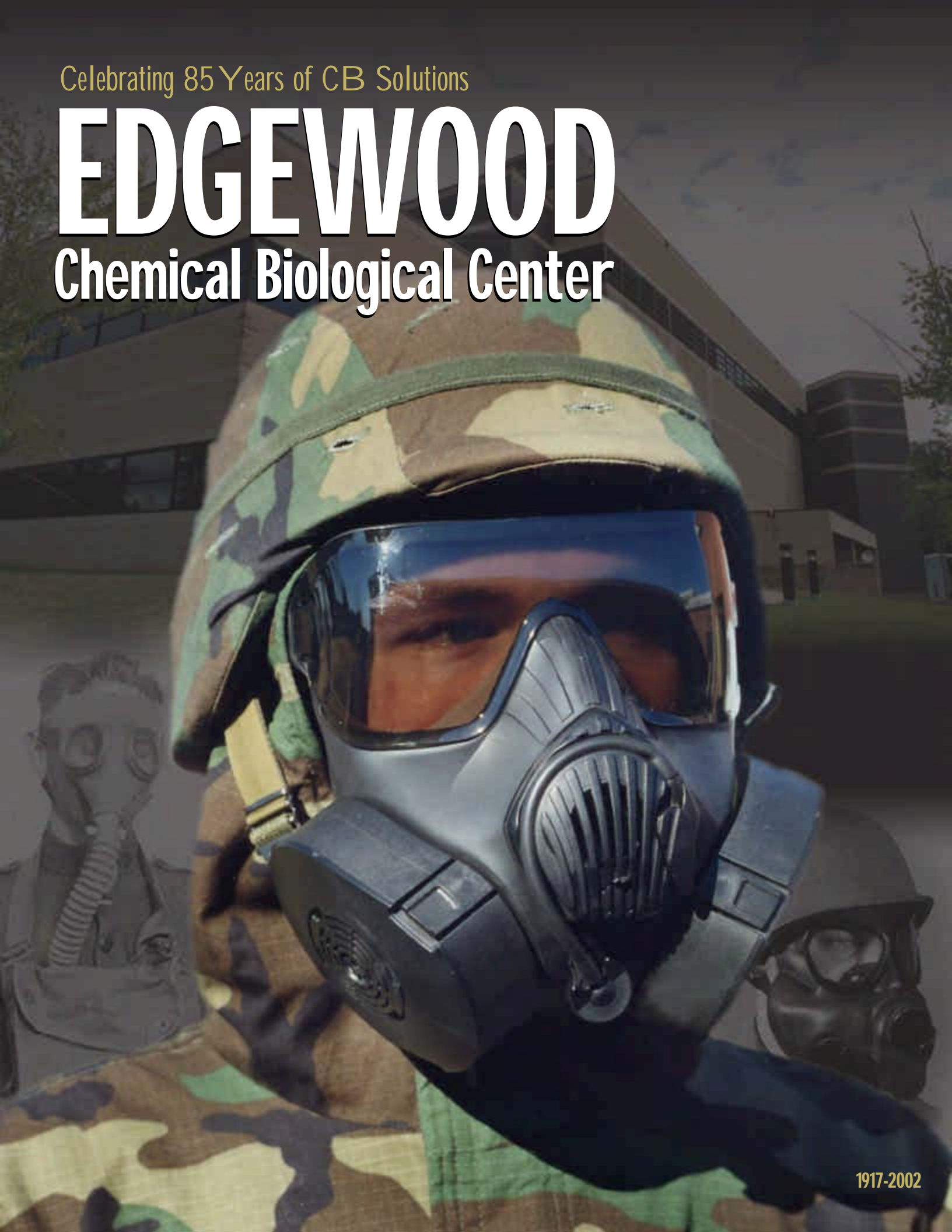


Celebrating 85 Years of CB Solutions

# EDGEWOOD

## Chemical Biological Center



1917-2002



US Army Soldier and Biological Chemical Command  
Aberdeen Proving Ground, Maryland 21010-5424

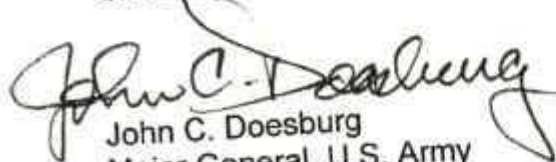
March 8, 2002

Edgewood Area, Aberdeen Proving Ground boasts a long and proud history of conducting chemical and biological (CB) research for the Department of Defense. No one else in this country, and perhaps the world, can do some of the things that we do here at Edgewood, or claim the far-reaching record of success.

The heart and soul of any organization is the people who comprise it, and the employees of the Edgewood Chemical Biological Center (ECBC) are outstanding examples of that. For years you have worked to protect our warfighters from CB agents on the battlefield. Using the most innovative technologies, you have developed some of the world's premier equipment in the CB arena. Technology transfer has brought your work even closer to home with the application of those same technologies to provide homeland defense and support for the war on terrorism.

Congratulations to all of you on the 85<sup>th</sup> anniversary of ECBC's, and its predecessor organizations', selfless and dedicated service to this great nation. It is an impressive milestone, of which you should be very proud. Your accomplishments and contributions in CB defense research are as remarkable as they are essential, which is confirmed by all of the government agencies and commercial businesses alike that continue to seek out ECBC's expert advice and assistance. Your service to our nation has been commendable and I wish you many more years of such distinguished success.

Sincerely,

  
John C. Doesburg  
Major General, U.S. Army



# Foreword

The challenges of chemical and biological (CB) defense have changed over the years, and the Edgewood Chemical Biological Center (ECBC) has also changed to meet those challenges.

ECBC is one of a few of the Army's and Department of Defense's total lifecycle research, development and engineering centers. ECBC possesses a full spectrum of capabilities ranging from basic and applied research, technology development, engineering, system acquisition to fielding and ultimately demilitarization.

The CB defense community is not large and demands very specialized knowledge and expertise. CB defense remains a boutique industry where a mix of science and craft is required to create a technology that can effectively protect our soldiers and homeland. ECBC's success over the past 85 years can be attributed to the dedication of its workforce and the application of science, craft, and hands-on experience.

ECBC employees are people that have dedicated their lives to understand the complexity of the CB challenge facing our warfighters and nation – and have taken on the selfless challenge of providing solutions. This publication is a tribute to the entire ECBC workforce; past, present, and future. Because of their efforts, ECBC remains at the forefront of CB defense as it has been for the past 85 years, and will be integral in keeping ECBC at the forefront in years to come.

In addition, I would like thank to all those who helped put this publication together.



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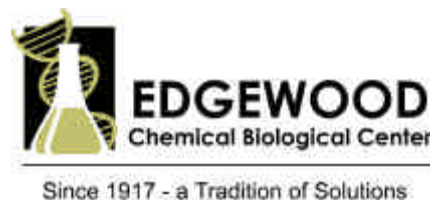
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## Our Heritage

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## 85 Years of Providing CB Solutions: The History of the Edgewood Chemical Biological Center



Since the first broad use of chemical weapons in World War I (WWI), scientists at what is now known as the Edgewood Chemical Biological Center (ECBC), have been actively researching the potential uses of chemical agents as weapons and technologies to protect U.S. warfighters from such weapons. Eighty-five years of experience put ECBC at the forefront in research and development (R&D) in chemical and biological defense for the United States. Since 1917, ECBC and its predecessors, located at the Edgewood Area of Aberdeen Proving Ground, MD, have been researching, developing, and testing technologies to safeguard U.S. warfighters and the nation from the harmful effects of chemical and biological warfare.

Prior to WWI, the area where ECBC is located, was a peaceful tract of land, known as Gunpowder Neck – a 20-mile peninsula stretching between the Bush and Gunpowder Rivers into the Chesapeake Bay. Before the area was settled in the 17th Century by Europeans, the land was home to the Susquehanna Indians. For years

after the Europeans settled here, the area was a place where they hunted and farmed.

In April of 1915, two years before the United States entered WWI, Germany initiated large-scale chemical warfare in an effort to win the war. The attempt failed, and soon both sides began using chemical weapons. Yet in April of 1917 when the United States joined the war, U.S. soldiers did not have training or equipment to fight in a war where chemicals were used.

To obtain the necessary chemical munitions, the U.S. Army required a site for a chemical shell filling plant. In late 1917, President Woodrow Wilson approved Gunpowder Neck as the site for the plant. Shell Filling Plant No.1 became operational in April 1918, and permanent buildings stood where wheat fields had been only a few months before. Eventually, two more shell filling plants were built along with chemical agent production plants. The area was named Edgewood Arsenal.

On June 28, 1918, all chemical warfare functions were consolidated under the Chemical Warfare Services (CWS). The CWS provided the U.S. armed forces with the best protective equipment and was in the process of producing chemical weapons when WWI ended.

After WWI ended, Edgewood Arsenal became the focus of all peacetime CWS field activities. In 1920, a new National Defense Act declared the CWS a permanent organization of the Army. Both retaliatory and defensive work continued at Edgewood on a peacetime basis.

In 1941, when the United States entered World War II (WWII), the CWS was again called to prepare the Army for possible chemical warfare. Many of the old plants had been removed, so new filling and production plants were built. The post was renamed the Chemical Warfare Center in 1942 to better reflect its overall mission. The Center's laboratories developed a wide range of new materials, including incendiary weapons and smoke generators as well as improved



gas masks. The Chemical School also expanded its program and trained more than 30,000 troops.

Since WWI and WWII, Edgewood has supported every major conflict the United States has been involved with. During the Korean War, Edgewood provided incendiaries, flamethrowers, smoke, and chemical mortars among other items. Likewise, Edgewood supported the Vietnam War with riot control agents and protective devices in addition to smoke and incendiary weapons.

Between wars, Edgewood continues its critical work in preparing warfighters and the nation to respond to chemical and biological threats.

In 1969, President Richard M. Nixon reaffirmed the “no first use” policy for chemical weapons and renounced the use of biological weapons. Other legislation during this time effectively ended open-air testing and significantly restricted the procurement of chemical weapons. As a result, the Army stopped producing chemical weapons and began disposing of the existing WWII stockpiles. In the early 1970s, the United States signed the Biological Weapons Convention, which ended biological retaliatory research. The remaining defensive aspects of biological warfare were transferred to Edgewood, and defensive biological research became a permanent part of Edgewood's mission.

Perhaps, one of the biggest political contributions Edgewood made was during the Cold War. A significant influence in bringing the Russians to the table to discuss a chemical weapons treaty was the successful program at Edgewood in developing retaliatory chemical munitions. As the first generation of binary chemical weapons neared production, the Soviets displayed a new-found willingness to meaningfully negotiate. One of the most notable munitions that Edgewood supported was the BIGEYE bomb. Edgewood played a major role in the testing and evaluation of the BIGEYE and in the extensive planning for two of the three facilities needed for the production of the BIGEYE. The BIGEYE was a binary

munition and contained two separate canisters each with a liquid compound. When the bomb is dropped, the canisters erupt, mixing the less toxic, non-agent liquid compounds to create a chemical agent, which then disperses on the designated target.

By the early 1990s, the United States had negotiated a bilateral chemical disarmament agreement with the former Soviet Union and a multi-lateral chemical weapons treaty that approximately 50 other nations signed. These treaties formed a major new area at Edgewood in Treaty and Arms Control Support.

Edgewood was the primary agency tasked with the hardware aspects of the R&D Program; that is, to determine the best personnel, near-term equipment, and procedures to fulfill chemical weapons treaty verification requirements. Part of this support included the establishment of a U.S. Treaty Laboratory at Edgewood for the purpose of sample analysis to support implementation of bilateral and multi-lateral chemical treaties. The Executive Agent for Chemical Weapons Treaty Compliance at Edgewood became the single agent for all matters related to compliance at chemical weapons storage and former production facilities on the eight U.S. Army installations where chemical stockpiles are stored.

Edgewood's Chemical Weapons Treaty Verification R&D has been integral in the support of the treaties. Structured on a melding of research and engineering with field exercises at declared treaty sites, Edgewood provided a wealth of practical information and data (based on actual experience) to treaty negotiators and action agencies. Edgewood provided reports and handbooks containing proposed treaty verification procedures, equipment, and personnel requirements to the United States and international agencies responsible for treaty implementation.

ECBC continues its support to the treaties by preparing installations for chemical weapons treaty inspections, joint training exercises, mock inspections, and data management and treaty reporting.

ECBC also has developed technologies for demilitarizing the United States' aging chemical stockpile and is active in the demilitarization process. Another highlight in Edgewood's R&D history is the extensive support that it gave to the Armed Forces during the Gulf War. This support included all aspects of Nuclear, Biological, and Chemical (NBC) defense – the troops, training, hardware, responses to inquiries from the troops, news media, and contractors negotiating for “surge” production of NBC protective equipment.

A major service that Edgewood provided during this time was an Emergency Operations Center that served as a focal point for all operational and logistical inquiries pertaining to chemical defense equipment and other chemical-related issues. Edgewood personnel also provided NBC training to deploying Army civilians, Department of Defense contractors, and military personnel. Not only did Edgewood provide training, but we also provided warfighters with ECBC-developed equipment such as protective masks, lightweight decontamination systems, skin protectants, and detection systems during the Gulf War.

After the Gulf War, Congress established the Joint Service Chemical and Biological Defense Program (Public Law 103-160). To support this new program, Edgewood expanded its mission to include support to all the services (Army, Navy, Air Force, and Marines). Since then, ECBC has fostered relationships with them in an effort to provide the best protection and equipment to the U.S. warfighters.

ECBC technologies and expertise are not only used to protect U.S. warfighters in foreign countries; but they are used right here, protecting U.S. soil and citizens. In 1996, ECBC added protecting the U.S. homeland to its mission. Since that time, ECBC has trained more than 28,000 first responders in 105 communities across the country as part of Congress' Domestic Preparedness Program.

The heart of Edgewood has always been the R&D program. Even though the organization's name has changed several times over

the years, the mission has remained the same: to protect the United States against the threat of chemical weapons and now, the threat of biological weapons. As threats of biological warfare increased, ECBC shifted its focus to both chemical and biological agent research.

Today, ECBC has an advanced biotechnology program and maintains a Critical Reagent Repository where personnel store and validate all immunological and DNA-based reagents for the entire Department of Defense. ECBC can produce enzymes, antibodies, and other cellular products and can provide project support from basic molecular biology to gene cloning.

Traditionally established to assist the Department of Defense and other government agencies, ECBC's scientists and engineers have expanded their horizons to assist the private sector. ECBC can partner with private industry and universities through formal agreements. ECBC scientists are able to patent their technologies and can enter into Patent Licensing Agreements with commercial businesses that may be able to market the technology to other organizations. ECBC researchers can also collaborate with commercial partners in a joint effort to solve CB problems as well as test technologies and equipment for other organizations.

Today, ECBC employs more than 1,000 people with a wide variety of scientific, engineering, and technical support disciplines. Technologies and expertise that ECBC has discovered and developed over the years can be seen today and throughout history all across the world. From masks to chemical and biological agent detectors, to sampling kits to smoke screen technologies, ECBC has helped to protect U.S. warfighters for the last 85 years through every major war or conflict the United States has been involved with. Even today, ECBC technologies and expertise can be seen helping in the U.S. fight against terrorism.

## Edgewood Chemical Biological Center Organizational Chronology

Since 1917, the organization that is now known as the Edgewood Chemical Biological Center has gone through several reorganizations and name changes. However, the mission of protecting the United States from the threat of chemical weapons and now the threat of biological weapons has remained the same through the years.

### War Gas Investigations/Bureau of Mines (1917-1918)

- In April of 1917 the Bureau of Mines' Department of the Interior established War Gas Investigations to study gases used in World War I.
- From April-September, War Gas Investigations work was conducted at various university chemical laboratories around the country.
- The Sanitary Corps, Medical Department, established a Gas Defense Service to provide gas masks for the Army.
- In September, War Gas Investigations moved to the American University Experiment Station.

### Research Division, American University Experiment Station (1918-1919)

- Executive order transferred the American University Experiment Station from the

- Bureau of Mines to the War Department.
- Chemical Warfare Service (CWS) was established to include a Research Division, Medical Division, Gas Defense Production Division, Development Division, and a Gas Offense Production Division. These divisions were located throughout the country.
- The American University Experimental Station disestablished and the organization moved to Edgewood Arsenal, and the Gas Defense Production Division was also assigned to Edgewood Arsenal.

### Technical Division, Edgewood Arsenal (1920-1942)

- The Technical division organized at Edgewood Arsenal included Chemical and Mechanical divisions.
- Technical Director assigned to coordinate all research, development, and proving activities at Edgewood Arsenal.
- Medical Research Division organized at Edgewood Arsenal.
- Technical Division reorganized at Edgewood Arsenal to include the Research, Medical Research, Munitions Development, Protective Development, Engineering Division, and Information Division.

### Research and Development Department (1942)

- Technical Division at Edgewood Arsenal reorganized as the Research and Development Department and Medical Department Research Laboratory.
- Edgewood Arsenal renamed Chemical Warfare Center.

### Technical Command (1942-1951)

- Research and Development Department, Edgewood Arsenal, became the Technical Command.
- Medical Department Research Laboratory redesignated Medical Research Division.
- Chemical Warfare Center redesignated Army Chemical Center.

### Chemical and Radiological Laboratories (1951-1956)

- Technical Command redesignated Chemical Corps' Chemical and Radiological Laboratories (C&RL).
- Medical Research Division redesignated Chemical Corps' Medical Laboratories.

# Our Heritage

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## Chemical Warfare Laboratory (1956-1960)

- C&RL and Medical Laboratories merged into Chemical Warfare Laboratories (CWL).

## Chemical Research and Development Laboratories (1960-1966)

- CWL redesignated Chemical Research and Development Laboratories (CRDL).
- Nuclear Defense Laboratories separated from CRDL as independent activity.

## Research Laboratories (1966-1971)

- CRDL replaced by Research Laboratories, Weapons Development and Engineering Laboratories (WDEL), and Defense Development and Engineering Laboratories (DDEL).

## Chemical Laboratory (1971-1977)

- Research Laboratories, WDEL, and DDEL abolished and replaced by the Chemical Laboratory, Biomedical Laboratory, and the Development and Engineering Directorate.

## Chemical Systems Laboratory (1977-1983)

- Chemical Systems Laboratory (CSL) established.
- Biomedical Laboratory transferred to the U.S. Army Medical Research and Development Command, Office of the Surgeon General.

## Chemical Research, Development, and Engineering Center (1983-1992)

- CSL redesignated Chemical Research and Development Center (CRDC).
- RDC redesignated Chemical Research, Development and Engineering Center (CRDEC).

## Edgewood Research, Development, and Engineering Center (1992-1998)

- CRDEC reorganized to form Edgewood Research, Development, and Engineering Center (ERDEC).

## Edgewood Chemical Biological Center (1998-present)

- ERDEC redesignated Edgewood Chemical Biological Center (ECBC) organized into four directorates: Research and Technology, Engineering, CB Services, and Advanced Planning and Initiatives



*Photo: The Toonerville Trolley was a narrow gauge railroad that carried visitors from the Edgewood railroad station to various stops in the Edgewood Area. This particular visit was the American Chemical Society in 1933.*



## Women in the Workforce



*Photo: Women filling gas mask canisters with charcoal.*

Women have been and will always be an integral part of the ECBC workforce. Women's involvement at Edgewood can be traced back to its establishment in 1917. In the early years, women worked in factories at Edgewood assembling gas masks designed to protect U.S. soldiers from deadly chemical agents.

Today, women are employed in all areas of ECBC's core competencies, including chemistry, biology, engineering, and "hands on" sampling and testing. The number of women in our workforce continues to grow; last year, more than 30 percent of ECBC's new hires were women.

At ECBC, our primary goal focuses on maintaining an exceptional workforce to meet the changing needs of our customers so that we can respond to any emergency throughout the world. Part of what makes this workforce so exceptional is the women of ECBC.



*Photo: Interior view of the gas mask factory at Edgewood Arsenal during the 1930s. One of the wings of the WWI Chlorine Plant was converted to a gas mask factory after the war. Women did most of the sewing for the gas mask facepieces.*



**Joint Service  
General Purpose  
Mask (JSGPM)**

## The Evolution fo the U.S. Gas Mask

As the first conflict of modern times to involve the entire global community, World War I (WWI) had far-reaching impacts socially and politically. Just as important, but less often mentioned in history books, are the changes WWI brought to the technology of warfare. For the first time, chemical agents were used as a weapon when German forces employed chlorine and other gases on British and French troops. This unprecedented tactic presented a challenge to the United States and its allies, who quickly needed to develop protective equipment that would allow their soldiers to survive a chemical attack and continue fighting even during exposure. The answer to this challenge was the gas mask, a piece of equipment that became an integral piece of the soldier's protective ensemble and continues to be developed and refined today. As the primary developer of the U.S. military gas mask, the Edgewood Chemical and Biological Center (ECBC), and its predecessor organizations, have been working to protect warfighters from agent attacks since the advent of these threats during WWI.

ECBC can trace its development of the U.S. gas mask back to 1917 when the United States entered WWI. After the end of the war, the War Department centralized all chemical warfare functions to Edgewood Arsenal, MD. However, the earliest attempts at gas masks can be traced back to the 16th century when Leonardo da Vinci described a mask to protect sailors against a toxic powder weapon. His design was simply a fine cloth dipped in water to cover the sailors' nose and mouth. It wasn't until 1849 that Lewis P. Haslett of Louisville, KY, was issued the first U.S. gas mask patent. He patented his Inhaler or Lung Protector "for protecting the lungs against the inhalation of injurious substances." The mask filter was wool or other porous substances moistened with water.

The evolution of the U.S. Army mask began during WWI, when Germans began using chlorine and other chemical gases against British and French troops. The British and

French began to develop gas masks to protect their soldiers. When the United States entered WWI, its soldiers were unprepared for chemical warfare and had to borrow the British and French masks.

In the beginning of the U.S. involvement in WWI, the responsibility for developing the U.S. gas mask fell on the Department of the Interior's Bureau of Mines, which attempted to adapt the British mask for American use with little success. After the war, the War Department centralized chemical warfare functions at Edgewood Arsenal. Throughout the ensuing years, the organization had many names and is today known as ECBC.

Once chemical warfare functions were centralized at Edgewood, the U.S. Army gas mask began to evolve. ECBC scientists continually research new technologies to improve the mask. As these new technologies are discovered, improved masks are developed to meet today's challenges. The following masks mark a few of the significant advancements in mask development at Edgewood since 1917.

### R.F.K. Mask

In early 1918, the Army developed the Richardson Floy Kops (R.F.K.) mask, which was an improved version of the British mask. The face piece was cotton fabric coated with rubber. The canister was smaller to create less breathing resistance. In addition to being more comfortable, the mask was also much easier to manufacture. Approximately 3 million of these were produced during WWI.



*Photo: Experimental WWI protective mask.*

### K.T.M. Mask

By the end 1918, the Kops Tissot Mask (K.T.M.) was developed, combining the best efforts of earlier masks. This mask had a stockinet-covered mouthpiece and used a new canister that added felt as a filter against toxic smoke particles. This was perhaps the best mask developed during the war, although only 2,000 were produced. During the 1920s and 1930s, the K.T.M. mask was improved and standardized as the M1 Mask, the first in a long series of masks standardized since WWI. This mask was discontinued in 1944.

### M5 Combat Mask

The need for a lightweight assault mask during World War II (WWII) resulted in the M5 Combat Mask, developed in 1944. The



R.F.K. MASK



K.T.M. MASK



M17 Mask



design was similar to a WWI German mask, but eliminated the hose to the canister and put the canister directly on the facepiece. The facepiece was made out of synthetic rubber and came in three sizes. The canister was lightweight but provided nearly the same protection as the heavier canisters. Over 500,000 M5 masks were produced during WWII. American troops that stormed Normandy on D-Day and during other amphibious operations carried this mask.

### M7 Mask

Shortly after the Normandy invasion, the need for gas masks for patients in hospitals with head wounds became a requirement. In 1944, the Army standardized its first mask designed to protect wounded soldiers. The hood was a Vinylite bag with an outlet valve and a lightweight canister.

### M14 Tank Mask

In 1953, Edgewood developed a collective protection mask system for armored tank crews. The facepiece was made of molded rubber in three sizes with a single plastic lens. A hose connected the mask to the air purifier and a cable connected a microphone to the tank's communication system. A standard canister was available when the mask was disconnected from the three-man collective protection system. Additional improvements resulted in the M14A2 Tank Mask in 1961.

### M17 Mask

To resolve problems associated with earlier masks, the M17 mask was developed in 1959 and eliminated the need for a separate canister by placing filter material in the cheek pockets of the mask. This also eliminated the need for right and left handed masks. A voicemitter was added to improve speech transmission. In 1966, a drinking tube was added to improve long-term wear. This mask was used extensively during Operation Desert Shield/Storm.

### M24 Aircraft Mask

The requirement for a protective mask for Army aircraft crews was initially established in 1933. Almost 30 years later, in 1962, the Army standardized a modified version of the M14 Tank Mask as the M24 Aircraft Mask. The mask comes in three sizes and has a backup canister for use outside the aircraft. It has an anti-glare eye lens outsert, a hood so it can be used over helmets, and an oxygen adapter for aircrafts with oxygen.

### M28 Riot Control Agent Mask

In 1968, during the Vietnam War, Edgewood developed the M28 Riot Control Agent Mask, a lightweight mask suitable for jungle warfare and protection against tear gas. The facepiece came in three sizes and the filtering material was located in the cheek pockets. More than 270,000 of these masks were produced prior to 1970. The mask was discontinued in 1977.

### XM30 Protective Mask

In 1979, the XM30 Protective Mask was developed, which had a large flexible bonded-in-silicone lens. This provided greater visibility than earlier masks. It had front and side voicemitters, a drinking device, rapid donning, and came in three sizes. The XM33 Aircraft Mask and the XM34 Combat Vehicle Mask were also developed. However, due to marring of the lens and other problems, the XM30 series was dropped in the early 1980s. Although the Army did not standardize the XM30 Mask, the Air Force liked the mask and completed its development as the MCU-2/P Mask, which was used both by the Navy and the Air Force during Operation Desert Shield/Storm.

### M40 Mask

Lessons learned from the XM30 Mask resulted in the M40 Mask series in 1987. The facepiece was made of silicone rubber and came in three sizes. This mask uses a replaceable canister on the facepiece. The Army uses improved versions of this mask today. In addition, the M42, M43, and M45 masks all provide protection to tank, helicopter, and aviation crewmembers.

### Joint Service General Purpose Mask (JSGPM)

Currently, ECBC is working on the JSGPM. This mask is a revolutionary advancement in protective mask technology, providing increased soldier, marine, airman, or sailor

**XM30  
PROTECTIVE MASK**



**M40 Mask**



performance. The JSGPM is being developed to replace the Army's M40 series and the Air Force and Navy's MCU-2/P Mask. The objective of this mask is to provide better protection, improved field-of-view, lower breathing resistance, and reduced weight. The mask is being developed through a performance specification sponsored by the Joint Services.

With 85 years of experience in mask development, it is no wonder that the nation's armed services are looking to ECBC to

develop the next generation of masks suitable for all of America's warfighters. Certainly, ECBC's research to develop the best protective mask will not stop with the JSGPM. As the challenges of the warfighter continue to change, so will ECBC in making sure that the protective mask meets these new challenges.



*Photo: 1930s soldier in mask demonstrating how to throw a chemical grenade.*

## Mickey Mouse Mask



*After the attack on Pearl Harbor, the Hawaiian Department developed a mask for children, which was a hood made of treated muslin with bunny ears so it would be less threatening. Although these types of emergency masks were issued following the attack, a better mask was needed to protect children. Edgewood, with the cooperation of Walt Disney, developed the Mickey Mouse Mask. Although never standardized or mass produced, approximately 1,000 of these masks were completed during World War II.*



## Our Heritage

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*Photo: The M31 Biological Integrated Detection System Alarm (BIDS)*



*Photo: The Warning and Identification Lidar Detector for Countering Agent Threats (WILDCAT).*



# History of Chemical and Biological Agent Detectors, Alarms, and Warning Systems

During World War I (WWI) when chemical weapons were broadly used on the battlefield for the first time, the United States realized that it not only needed to protect its soldiers from these chemicals through the use of gas masks and clothing – but soldiers also needed the ability to detect chemical agents and warn fellow soldiers. At the same time what is now known as the Edgewood Chemical Biological Center (ECBC) began working on the U.S. gas mask, it also was tasked to develop technologies to detect and warn against chemical and biological attacks.

When the United States entered WWI in April 1917, although chemists in laboratories had the ability to identify chemical agents, the U.S. Army had no ability to detect chemical agents either as vapor or on surfaces in the field. Instead, the American soldier had to rely on his own senses (smell or throat and nose irritation) to detect chemicals. Since most of the WWI chemical agents had unique odors, the sense of smell was the best detector. For example, troops learned that German mustard agent smelled like mustard. Allied mustard agent smelled like garlic. Gas scouts were trained and positioned to provide advance warning to the main trench line of an incoming gas cloud. When the troops already had their masks on and needed to check for chemical agents, they had to perform what became known as the sniff test. This involved pulling the edge of the gas mask away from the face to allow outside air to enter the mask. If a chemical agent was present, the specific odor would alert the soldier to remain masked. Unfortunately, the sniff test was inaccurate for low levels of chemical vapor. In addition, after conducting the sniff test for several hours, a soldier would gradually lose his ability to detect low levels of mustard agent. Of course, in high levels of mustard agent, the sniff test was extremely dangerous.

The dangers of the sniff test led Edgewood to test several concepts for a vapor field

detector that did not involve removing the gas mask. The first of which was the Copper Flame Test Lantern. This test relied on a reaction between mustard agent and copper, in which the lantern's flame would turn blue-green if mustard agent was present in the air. Other detection devices during WWI were the use of dyestuffs that changed color when in contact with mustard agent and the use of animals' reactions, including slugs, to detect the presence of chemical agents.

Once chemical agent was identified by the sniff test or another early method, soldiers would use anything that made a loud noise to alert other soldiers, including whistles, horns, rattles, bells, and sirens. However, some of these alarms created problems because they were hard to distinguish between other loud sounds. So, in 1924, Edgewood standardized horn and rattle alarms as official gas alarms.

Since WWI, ECBC has developed several chemical and biological agent detection and warning systems. Some milestones in the development of these detection systems and alarms include:

## M1 Gas Alarm

During World War II (WWII), the Army tested a number of percussion-type gas alarms. They included triangles, tubes of various materials, cylinders, 75mm and 105mm shells casings, and drums. Of all the items tested, the metal hollow tube in a U-shape proved the most satisfactory. The final result was the M1 Gas Alarm, standardized in 1942. It was a steel tube and a striker also made out of a steel tube with a wooden handle. Over 77,000 M1 Alarms were procured during the war. The alarm was obsoleted in 1951.

## M4 Mustard Agent Vapor Detector Kit

The 1934 requirements for a chemical agent detector were not met until WWII. The first standardized item was the M4 Vapor

Detector Kit, which could detect even faint concentrations of mustard agent. The M4 HS Vapor Detector Kit was standardized in 1942. The key to its detection capability was a new reagent that reacted with mustard agent to give an intense color change. The kit was reclassified as limited standard in 1943 when the better M9 Detector Kit was standardized. It was finally obsoleted in 1945.

## M5 Liquid Detector Paint

In early 1941, Edgewood investigated British detector paint that used a blue dye that turned red when liquid drops of mustard agent reacted with it. This concept eventually led to the development of M5 Liquid Vesicant Detector Paint that was standardized in 1942. The paint was olive and turned red when it came into contact with liquid mustard agent. Over 7.8 million 4-ounce cans of the paint were procured during WWII. After the war, it was found that the paint also reacted similarly to nerve agents. M5 Detector Paint was obsoleted in 1956.

## M6 Liquid Detector Paper

The Army took the M5 Detector Paint and applied it to paper, cut it up in small pieces, and bound them in a booklet form, which was standardized as M6 Liquid Agent Detector Paper in 1942. Over 1.1 million books of 25 sheets were procured during WWII. The paper functioned similar to Detector Paint and required liquid mustard agent to fall on the paper to react. After the war, the paper was found to detect nerve agents in a similar manner. M6 Liquid Agent Detector Paper was obsoleted in 1963.

## M7 Detector Crayon

The need for a detection capability that could detect mustard agent already on a leaking chemical shell or other surfaces resulted in the concept of the detector crayon. The crayon could be rubbed on a surface or

crumbled and then sprinkled over a suspected contaminated surface. Upon contact with mustard agent, the pink color of the crayon turned blue. The M7 Vesicant Detector Crayon was standardized in 1942. Over 600,000 packs of the crayons were procured during WWII. After the war, it was discovered that the crayon also reacted with nerve agents, turning yellow instead of blue. The M7 Crayon was obsoleted in 1965.

### M9 Chemical Agent Detector Kit

The development of the M9 Chemical Agent Detector Kit in 1943 proved to be one of the most significant developments at Edgewood during the war. The kit could detect small amounts of 11 different chemical agents. Color changes indicated the presence of specific chemical warfare agents. It was simple to use and did not require a chemist to perform the tests. Over 82,000 M9 Kits were procured during WWII. The M9 Kit was obsoleted in 1954, and the remaining stockpile converted to M9A2 Kits.

### M2 Chemical Agents Water Testing Kit

During WWII, the Army Medical Service developed chemical agent testing kits for water and food. After the war, the kits were improved by the Medical Service to detect nerve agents. In 1952, the Department of the Army recommended the kits be assigned to Edgewood that standardized the M2 Chemical Agents Water Testing Kit in 1953. It was designed to detect contamination of unchlorinated water by chemical warfare agents. It was not effective for use with chlorinated water. The kit was obsoleted in 1996.

### M3 Chemical Agents Food Testing and Screening Kit

The M3 Chemical Agents Food Testing and Screening Kit was standardized in 1953. The kit was used in the field to detect contamination in food or food packages by chemical warfare agents. It was designed to test for arsenics, mustard, and nerve agents. Over 10,000 of the kits were eventually procured and issued to medical units, survey teams, veterinary inspectors, and bakery units. Although improved over the years, the M3 Kit was obsoleted in 1967.

### M4 Poisons Water Testing Kit

The Army standardized the M4 Poisons Water Testing Kit in 1953. It was used to make qualitative determinations of mustard agent, arsenics, the G-agents, cyanide agents, and other heavy metal poisons in water. It was designed for Army Medical Service personnel to certify drinking water supplies. The kit was obsoleted in 1959 when the M4A1 Kit replaced it.

### M5 Automatic G-Agent Fixed Installation Alarm

In 1951, the Army began requiring an alarm for nerve agent production and storage facilities. After 7 years of development, the M5 Automatic G-Agent Fixed Installation Alarm was standardized in 1958. This was the first automatic nerve agent detector and alarm standardized by the U.S. Army. The unit could detect G-agent and sound an alarm in about 10 seconds. Unfortunately, the unit was 7 feet high and weighed 725 pounds. Each unit cost over \$10,000 and required continuous fluid replacement to remain active. Only 31 units were procured. The M5 Alarm was obsoleted in 1979.

### M6 Automatic G-Agent Field Alarm

The first automatic G-agent field alarm was standardized for the Navy in 1959. This was also the first electronic device developed for field use. Color formed when any G-agent came into contact with a reagent. If color developed, the buzzer alarm triggered. As designed, the alarm would function continuously unattended for a 12-hour period at which time it required maintenance. One problem with the alarm was that it did not function below freezing. Another problem was that it ran off a battery. The M6 Alarm was obsoleted in 1970.

### M8 Chemical Agent Detector Paper

M8 Chemical Agent Detector Paper was standardized in 1963. The paper was a Canadian development and reacted with liquid chemical agents by turning dark blue for V-agents, yellow for G-agents, or red for mustard agent. A color chart on the inside cover of the booklet provided samples of the responses. One problem with the paper was

that some less dangerous liquids gave positive responses.

### M8 Automatic Chemical Agent Alarm

For the U.S. Army, the 1967 Arab-Israeli War demonstrated the important need for an automatic field alarm system for the detection of nerve agent vapor. In 1968, the Army standardized the M8 Portable Automatic Chemical Agent Alarm. The 4-year development program was one of the most significant accomplishments in chemical defense and corrected a major deficiency that had left U.S. soldiers vulnerable to a surprise nerve agent attack. The detector continuously monitored the atmosphere and sounded an audible or visible warning of even very low concentrations of nerve agents. The unit could detect almost all known chemical agents. In 1971, the M8 alarm was reconfigured into ten different configurations for various vehicles and for field and installation use. The M8 Alarm was obsoleted in 1996.

### M256 Chemical Agent Detector Kit

During the 1970s, the Army continued to improve the basic detector kit and standardized the M256 Chemical Agent Detector Kit in 1977. The M256 Kit could detect chemical agents in the air and liquid chemical agent contamination on surfaces. The primary use was to notify troops as to when they could unmask after a chemical attack. The M256 Kit was obsoleted when the M256A1 Kit replaced it in 1986.

### Chemical Agent Monitor (CAM)

The urgent need for a lightweight hand-held chemical agent detector and the movement to microprocessors was reflected in the development of the Chemical Agent Monitor (CAM) standardized in 1988. It was a hand-held device for monitoring chemical agent contamination on personnel and equipment. The small unit weighed about 5 pounds.

### Improved Chemical Agent Monitor (ICAM)

Starting in 1989, the Army began a program to improve the Chemical Agent Monitor (CAM) by replacing the electronics board. The Improved Chemical Agent Monitor (ICAM) was standardized in 1993 and improved reliability, reduced maintenance

costs, and eliminated the need for depot repair.

## M93 NBC Reconnaissance System (Fox)

During Operation Desert Shield in 1990, the Army issued the first XM93 series Nuclear, Biological, Chemical (NBC) Reconnaissance System (Fox). The XM93 Fox was a dedicated system of NBC detection, warning, and sampling equipment integrated into a high speed, high mobility armored carrier. The Fox was capable of performing NBC reconnaissance on primary, secondary, or cross-country routes throughout the battlefield and had the capability to find and mark chemical and biological contamination. While conducting the reconnaissance, the four-man crew was protected by the inclusion of an on-board overpressure system. The initial production was 48 vehicles with an additional 65 vehicles rushed into the field during Operation Desert Shield/Storm (ODS). The use of the XM93 Fox in ODS quickly proved its value.

## M21 Remote Sensing Chemical Agent Alarm (RSCAAL)

The concept of a remote sensing chemical agent alarm started in the 1950s, but research on the project continued throughout the 1970s and 1980s. Finally in 1995, the Army standardized the M21 Remote Sensing Chemical Agent Alarm. The M21 was an automatic scanning, sensor, which detected nerve and blister agent vapor clouds out to 5 kilometers. The M21 was mounted on a tripod or on the M93A1 NBC Reconnaissance Vehicle. First deployment to the frontlines occurred when six M21 Alarms were deployed to Kuwait in 1996.

## M22 Automatic Chemical Agent Alarm (ACADA)

The M22 ACADA program started in the 1970s. After continuous development, the final version was type classified standard in 1997. The M22 was man-portable, operated independently after system start-up, and provided an audible and visual alarm. The unit simultaneously detected both nerve and blister agent vapor and was suitable for monitoring collective protective shelters. It was significantly more sensitive than

previous systems and less susceptible to interferences. The M22 system also provided communications interface for automatic battlefield warning and reporting.

## M31 Biological Integrated Detection System (BIDS)

After the Gulf War, General Colin Powell testified to Congress that the United States was vulnerable to biological warfare. One reason was that the United States had been unable to standardize a good biological agent detector. In 1996, the BIDS was standardized. The BIDS is a small truck packed with sampling and detection equipment. Each vehicle can provide 24-hour monitoring with identification of the agent following an alarm in about 30 minutes.

## Joint Service Lightweight Standoff Chemical Agent Detector (JSLSCAD)

The JSLSCAD is a state-of-the-art detection system designed to provide all the U.S. forces with enhanced capability in detecting chemical warfare agents. It is a lightweight, passive and fully automatic detection system that scans the surrounding atmosphere for chemical warfare agent vapors. It furnishes on-the-move, 360-degree coverage from a variety of tactical and reconnaissance platforms at distances up to 5 kilometers. The JSLSCAD provides warfighters with enhanced early warning to avoid chemically-contaminated battlespaces. When avoidance is not possible, the JSLSCAD will give personnel extra time to put on protective gear.

## Biological Attack Warning System (BAWS)

The Biological Attack Warning System (BAWS) is the first successful real-time, lightweight biological alarm system. From 1996 to 1999, ECBC developed BAWS, which is a remote sensor system designed to warn against a biological incident before exposure. The BAWS uses a high-powered ultraviolet laser that hits aerosol particles, which respond by emitting light. The BAWS then analyzes the resulting light for characteristics unique to biological agents.

This process takes a matter of seconds, enabling the BAWS to instantaneously detect the presence of a hazard.

## WILDCAT

The Warning and Identification Lidar Detector for Countering Agent Threats (WILDCAT) uses laser-based technology to detect airborne chemical agents in aerosol and vapor forms. WILDCAT can perform on-the-move instantaneous coverage at distances up to 20 kilometers. Because WILDCAT combines an aerosol detection capability with two modes of vapor detection and increases detection ranges by 4-8 times or more compared to current standoff detectors, it is a one-of-a-kind tool.

## Joint Biological Point Detection System (JBPDS)

The JBPDS is the successor to the Biological Integrated Detection System (BIDS) and is designed for use by all four U.S. military services. The JBPDS is capable of identifying multiple biological agents in less than 15 minutes, and can be integrated onto ships, vehicles, and airbases providing detection capability. The JBPDS increases the number of agents that can be identified, decreases identification and detection times, increases detection sensitivity, and provides a first-time point detection capability to the Air Force and Marine Corps.

The ability to detect and provide advanced warning to troops to unseen threats such as chemical and biological agents has always been a primary initiative at ECBC. In more recent years, ECBC has focused on the detection of biological agents.

Operation Desert Storm/Shield brought to the forefront the concerns of biological warfare. Since that time, ECBC has developed three generations of biological detection systems in less than 10 years, which exemplifies the significant advancement that ECBC has been able to accomplish in this field.



**/// The proof of ECBC's capabilities, responsiveness, and versatility was borne out immediately following August 2, 1990, with the Iraqi invasion of Kuwait. As quickly as the immediate threat of CB warfare to U.S. Forces and its Allies was envisaged, requirements for materiel assistance, training, analyses, and modeling poured into the center. We continue today to give immediate service on an around-the-clock basis to each of the Armed Services. ///**



*Photo: Soldier testing for chemical agents using a CAM (Chemical Agent Monitor).*

## Edgewood's Support to Operation Desert Shield/Storm



On August 2, 1990, Saddam Hussein sent Iraqi troops into Kuwait allegedly in support of Kuwaiti revolutionaries who had overthrown the Emirate. By August 8th that same month, the pretense was dropped, and Hussein announced that Kuwait had simply been annexed and was now a part of Iraq.

In response, President George Bush (senior) sent U.S. forces to Saudi Arabia at the request of the Saudi government. This became known as Operation Desert Shield. The United States' response to Iraq's invasion put the U.S. Army's chemical and biological (CB) warfare experience, training, production program, and lessons learned in the limelight.

Much of the CB protective technology, equipment, and expertise for the U.S. military came from the Army's Chemical, Research, Development, and Engineering Center, which is now called Edgewood Chemical Biological Center (ECBC). Part of the challenge was meeting a change in needs and requirements based upon the situation confronting U.S. forces. Not since World War I (WWI) had our troops been sent to face an enemy who had used

chemical weapons extensively within the last few years. In addition, Iraq had publicly announced its intentions to use chemical weapons against the United States. It was estimated that Iraq had 1,000 tons of chemical weapons loaded in bombs, artillery rounds, rockets, and missiles.

Iraq also had a large biological agent production facility that produced botulism, anthrax, and other agents. Started in 1988, the plant was designed to produce about 11,000 gallons of agent per year. Much of Iraq's biological weapons' program remained unknown until after the war. After stating for years that the plant was used to produce animal feed, the Iraqis admitted in 1995 that the plant was a biological warfare production facility.

The threat of a potentially chemical or biological war posed new challenges to the U.S. military. On August 21, 1990, the Office of the Secretary of Defense issued a memorandum containing the following critical statement: "Desert Shield has already revealed gaps in our preparedness for chemical/biological defense." The memorandum went on to list six general categories of

apparent shortfalls. These were: (1) simple, transportable collective protection, (2) vehicle collective protection/cooling, (3) new generation masks, (4) miscellaneous consumable CB defense materiel, (5) realistic and timely intelligence, and (6) management upgrades.

The identification of these perceived deficiencies represented a daunting challenge for ECBC in preparing U.S. warfighters for a possible chemical war. The initiation of Operation Desert Shield caused an unplanned mission requirement that affected the entire workforce. The necessary support required long hours, weekend work, and in some cases, long trips to Southwest Asia. This intense support covered all aspects of Nuclear, Biological, and Chemical (NBC) defense – the troops, training, hardware, responses to inquiries from the troops, news media, and contractors negotiating for "surge" production of NBC protective equipment.

ECBC conducted analyses to provide preliminary information on Iraq's CB warfare capabilities. Efforts included an assessment of the agents and delivery



systems reported to be processed by Iraq; preliminary estimates of the area these weapons could be expected to contaminate in a desert environment; and estimates of the persistency of this contamination at high desert temperatures. These results were provided to the field and served as the basis for guidance to units that may have to operate in a chemical environment.

In August 1990, ECBC activated the Emergency Operations Center to serve as the focal point for all operational and logistical inquiries pertaining to chemical defense equipment and other chemical-related issues. Between August 1990 and the end of the operation, the Emergency Operations Center responded to more than 2,200 inquiries from a variety of Army and other service headquarters. The coordinated response enabled field commanders and headquarters' staff officers to assess and improve their chemical defense readiness. In October 1990, ECBC was also tasked to provide NBC training to deploying Army civilians, Department of Defense contractors, and military personnel. The office planned, organized, and staffed a training team that provided NBC training, including mask issue and fit validation, to more than 3,000 personnel deploying to the Persian Gulf.

Soon after soldiers were sent to Saudi Arabia, ECBC's mission to provide soldiers with the best equipment became more critical. Congress voted in January 1991 to give President Bush the authority to go to war against Iraq. The actual attack on Iraq was on January 16, 1991, as part of the United Nations' mandated effort to free Kuwait, designated Operation Desert Storm.

The attack escalated the concern and fears of a new chemical war on the level of WWI. The initial air attack concentrated on Iraqi chemical production facilities, bunkers, and lines of supply. During the air phase, Hussein told CNN News that his Scud missiles, already hitting Israel and Saudi Arabia, could be armed either with chemical, biological, or nuclear munitions. Then Vice President Dan Quayle, while visiting the United Kingdom, stated that the United States had not ruled out the use of chemical or nuclear weapons. In fact, the United States threatened to target Hussein personally if he used chemical

weapons against Allied troops. Iraq, in turn, threatened to use chemical weapons against Allied troops if they continued the high level bombings against Iraqi troops.

Thus, the stage was set for what many thought was going to be the second major chemical war in the 21<sup>st</sup> Century. When the Allies began the ground war in February, the worst was expected and planned for by CB warfare specialists. Rumors of chemical warfare surfaced on the second day, but none were verified. Chemical alarms went off across the battlefield on a regular basis, but all were dismissed as false alarms.

As U.S. involvement in the Middle East escalated so did ECBC's efforts. In addition to establishing the Emergency Operation Center, equipment developed by ECBC was used extensively by warfighters during Desert Storm. Items that were accelerated for use during the war included the M40 series CB protective masks, collective protection equipment, lightweight decontamination systems, skin protectants, and detection systems. Some notable technologies that ECBC accelerated the development of for use by U.S. forces included:

### Improved Individual Protection

One of the improvements called for in the Office of the Secretary of Defense's memorandum was the fielding of an improved mask. The M17 mask was the primary mask used by troops but could not fit some "hard to fit" faces of the soldiers. One estimate was that when any mask is produced, it would not fit about one percent of the target population. To correct this problem, ECBC provided the M40 mask. The M40 mask, like the M17 mask, was designed to protect the warfighter's face, eyes, and respiratory tract from all known chemical, biological, and riot control agents. The mask also had both front and side voicemitters so the warfighter could communicate through the mask.

### Portable Detection Capability

The M1 Chemical Agent Monitor (CAM) was one of the most important programs that ECBC expedited during Operation Desert Storm. The CAM was a hand-held, soldier-operated point detector for monitoring

chemical agent contamination on personnel and equipment. The CAM, which weighed about five pounds, detected chemical agent vapors. In December 1990, ECBC established a CAM Mobile Training Team to support the fielding of the CAMs to overseas soldiers.

### On-the-Move Detection and Warning Capability

During Operation Desert Storm/Shield, the Army decided to expedite the fielding of the XM93 Nuclear, Biological and Chemical Reconnaissance System (NBCRS). This allowed soldiers to find and mark contaminated areas on the battlefield. The NBCRS was a detection, warning, communication, and NBC intelligence system integrated into a six-wheeled armored vehicle. The NBCRS was a major improvement over earlier reconnaissance systems because it could perform reconnaissance missions while moving and had state-of-the-art collective protection and detection equipment. In less than 40 days, the Army was able to deploy this system. Approximately 60 of these systems were deployed during Operation Desert Shield/Storm.

### Filling the Gap in Biodetection

With the beginning of Operation Desert Shield, it became apparent that detection of biological warfare agents would be an essential part of overall defensive capabilities. The Office of the Secretary of Defense directed ECBC to provide a biological detector. A team of ECBC experts determined the best approach was to develop an expedient, limited biodetection capability that could be fielded within weeks. To do this, ECBC combined two technologies to develop the XM2 Biological Agent Sampling system. This system consisted of the XM2 Biological Agent Sampler, which collected and concentrated biological agent aerosols. Detector tickets then would give positive or negative indication of the presence of agent within 10-20 minutes of exposure to the collected fluid. In December of 1990, ECBC personnel traveled to Saudi Arabia to test the new equipment; and by January of 1991, XM2 samplers were fielded and warfighters were trained at ECBC.



On February 27, 1991, Allied troops liberated Kuwait City and finished destroying Iraqi divisions originally in Kuwait. No known, overt, large-scale CB attacks were made by the Iraqis during the war. A number of reasons surfaced after the war as to why the Iraqis had not initiated large-scale CB warfare. Vice Admiral

Stanley Arthur, commander of U.S. naval forces, thought that because the wind suddenly changed from blowing south at the start of the land battle, the Iraqis had probably realized chemical weapons could harm their own troops. Some thought the speed of the campaign was the critical reason. Others reported that the combination

of Allied bombing and resulting Iraqi logistical nightmares prevented the chemical weapons from ever reaching the front lines. Some thought that Iraq might have feared nuclear retaliation. But whatever the reasons, ECBC worked then and continues to work now to protect United States against Weapons of Mass Destruction.



## Gulf War Spurs Advancement in Bio-Detection

In the wake of the Persian Gulf War, then chairman Colin Powell, testified before Congress that the United States was well-equipped to deal with chemical and nuclear threats; however, it was not well-prepared for a biological threat. That candid assessment served as a wake-up call and led the U.S. Army to establish the Office of Program Director for Biological Defense Systems at Edgewood, MD.

In less than four years, the Army designed, built, and fielded the military's first unit whose sole mission was to detect the use of biological weapons. The system, known as the Biological Integrated Detection System (BIDS), was taken from concept to fielding of the first unit in less than four years. The multi-purpose system provides monitoring, sampling, detection, and identification of biological warfare agents.

The BIDS consists of a shelter mounted on a dedicated vehicle, equipped with a biological detection suite employing complementary technologies to detect large-area biological attacks. Initially, a non-developmental item, the BIDS consisted of off-the-shelf instrumentation, providing a limited manual detection/identification capability. This was followed by a pre-planned product

improvement, resulting in the BIDS P3I that has an expanded and semi-automated detection/identification capability.

Today, Edgewood has already developed the third generation of biological detection, known as the Joint Biological Point Detection System (JBPDS). This is an impressive accomplishment considering Edgewood developed the first generation biological detection system only nine years ago.

The JBPDS provides a fully automated, broad-spectrum biological detection/identification capability, which is an improvement over earlier systems. The JBPDS is also the first system developed for use by all the military services. The JBPDS is currently being used.

In October 2001, after the terrorist attacks of September 11th, the Deputy Secretary of Defense directed that Chemical and Biological detection and identification equipment be procured for high-priority defense sites. The JBPDS was specifically identified since it is fully automated and has a much lower cost of operation than existing systems.

To make this early deployment possible, the Program Manager for the JBPDS turned to the Edgewood Chemical Biological Center (ECBC). ECBC proposed that the JBPDS be mounted in a commercial trailer in a configuration called the JBPDS Homeland Defense Trailer. In just four short weeks after ECBC received the request, eight trailers were completely outfitted. These trailers containing the JBPDS are currently stationed around high-priority defense sites in the United States.





## After 85 Years, Still Meeting CB Defense Needs of Today and Tomorrow



*Photo: Testing the drinking tube of a CB protective mask.*

Since 1917, the Edgewood Area of Aberdeen Proving Ground, MD, has steadily built an exemplary program in chemical and biological (CB) defense research. While many agencies and organizations today are engaged in matters related to chemical and biological defense, it is the Edgewood Chemical Biological Center (ECBC) that remains the “hands on” research, development, and applications leader.

Over the years, ECBC not only strived to protect the U.S. government and its warfighters, but it also strives to protect the nation and its citizens. At the heart of this effort are the employees of ECBC, who are continuing a proud 85-year tradition in chemical and biological warfare defense. ECBC has a diverse workforce of more than 1,000 dedicated employees with a wide variety of scientific, engineering, and technical support backgrounds. In fact, scientists and engineers make up over half of ECBC’s workforce.

Many of ECBC’s employees have been recognized as experts in their field by various government agencies, commercial partners,

media, and other experts in chemical and biological defense. Over the years, employees have received many prestigious awards and recognition for their advances in research, including the U.S. Army Research and Development Achievement Award, former Vice President Al Gore’s Hammer Award, Maryland Chemist of the Year Award, the U.S. Army Hazardous Waste Minimization Incentive Award, the Maryland Quality Award, and an appointment as Congressional Science Fellow of the Society of Toxicology.

ECBC scientists are extensively published in a number of prestigious scientific journals, including the *Journal of Applied Toxicology*, *Journal of Applied and Environmental Microbiology*, *Journal of Applied Chemistry*, and the *Journal of Applied Optics*. Personnel are also routinely called for interviews with a variety of media, including **Newsweek**, **New York Times**, and **National Public Radio**. This talented workforce has made ECBC a world leader in applying state-of-the-art science, technology, and engineering to chemical and biological defense problems.

Since 1917, ECBC has primarily been strong in research for protection against chemical agents. However, ECBC has had a supporting role in biological expertise that dates back to WWII. As a result of Operation Desert Storm/Shield, ECBC aggressively brought its biological expertise up to the same level as its chemical expertise.

A snapshot of ECBC today shows its employees organized into four directorates that allow them to research, develop, test, and field technologies with the goal of protecting U.S. warfighters and our homeland from both chemical and biological agents. These directorates are Research and Technology, Engineering, CB Services, and Advanced Planning and Initiatives.

The Research and Technology (R&T) Directorate is the source of chemistry, biology, toxicology, and aerosol physics expertise for CB solutions. R&T couples basic science with engineering to identify technologies for future development. Technologies include CB agent detectors and warning systems, decontamination technologies, and protective masks. R&T





*Photo: Individual CB Protection*



*Photo: Computer Aided Engineering*



*Photo: Chemical bio-filtration*

operates a number of unique laboratories capable of working with chemical and biological agents, including a Biosafety Level 3 (BL3) laboratory. This laboratory allows cutting-edge research on pathogens. R&T also has the Department of Defense's only pilot-scale biomanufacturing capability, the Process Engineering Facility.

In R&T, employees perform a wide range of studies including the effects of CB agents on warfighters and the environment. R&T counts among its employees two Army Senior Technologists (STs). STs are senior scientists who are selected on the basis of scientific accomplishments such as publications in refereed journals and reputation in their field. They are the Army's most senior scientists and advise senior Army leadership at Command and Department of the Army levels, in addition to their duties at ECBC. Currently, the entire Department of the Army has 33 STs. ECBC is proud to have two out of that 33.

While R&T scientists specialize in developing CB technologies, the Engineering Directorate helps to mature these technologies into actual products. Engineering Directorate personnel take transitioned technologies and develop and test them resulting in the production of end items that are ultimately fielded. State-of-the-art engineering capabilities such as computer-aided engineering and design and toxic/environmental test chambers are used to facilitate development and production activities. The Engineering Directorate also leads ECBC's efforts in Homeland Defense.

Through the Congressionally-mandated Domestic Preparedness Program, initiated in 1996, ECBC trained first responders across the country, enhancing nuclear, biological,

and chemical preparedness nationwide. Between 1997 and 2000, ECBC helped to conduct more than 230 Weapons of Mass Destruction Exercises. This training helped to enhance the capability of federal, state, and local emergency responders in incidents involving chemical, biological, radiological, or nuclear weapons. Today, ECBC continues to support the Department of Justice that now has the mission of training the emergency management community to respond to CB incidents.

One of the strongest "hands on" elements at ECBC is its CB Services Directorate, which provides a full range of chemical surety and biological materiel management services. The directorate applies its CB agent handling and chemical weapons expertise to address munitions and demilitarization problems, assess and reduce risk posture, support CB agent operations, and develop risk management standards. CB Services is ECBC's focal point for United Nations' (UN) support in chemical- and biological-related matters. It provides CB-specific training, advice and planning to the UN Monitoring and Verification Inspection Center. CB Services' employees also work closely with other federal agencies. For example, we are working with the National Institute of Occupational Safety and Health to develop respiratory standards for CB equipment.

The Advanced Planning and Initiatives Directorate (AP&I) pulls together the mission of the center and leverages all the capabilities that ECBC possesses. AP&I is responsible for strategic planning for the entire center as well as technical outreach. AP&I ensures that ECBC's technological breakthroughs and scientific expertise are transitioned to non-Department of Defense organizations, including other government

agencies, industry, and U.S. allies throughout the world. AP&I also manages an extensive program of international scientific and technical collaboration in CB defense on behalf of the Joint Services. AP&I personnel establish policy for all foreign and international activities involving technology exchanges and international agreements on behalf of ECBC. They also identify, plan, and develop cooperative efforts between foreign governments and the U.S. military in the area of CB defense. AP&I's active pursuit of technology transfer was recognized by the Federal Laboratory Consortium who presented ECBC an Award for Excellence in Technology Transfer.

Recognizing the need to stay at the forefront of CB defense research, ECBC is modernizing its infrastructure. ECBC's laboratories, chambers, computer systems, and fabrication facilities are kept up-to-date. A life sciences research facility and a state-of-the-art biotechnology facility are the newest additions to the more than 25 facilities ECBC operates. These facilities give ECBC more than 1,500,000 square feet of space, approximately 57 percent of which is laboratory space. Construction of a new Advanced Chemistry Laboratory at Edgewood is to begin this year. This will be the first new ECBC facility of the millennium.

Its workforce and infrastructure make ECBC a unique national asset. ECBC counts among its customers nearly every federal agency. Many of these agencies look to ECBC for continued support in combating terrorism. ECBC's facilities, operated by its well-trained, experienced workers, ensure national defense needs are met in a safe and environmentally responsible manner.



*Jim Zarzycki*

## Interview: Director, Edgewood Chemical Biological Center Technical Director, SBCCOM RDEC J.H. Zarzycki

**Q. It appears that the world is going through a transformation now. As a result, the Army is transforming. How is this transformation affecting the work being performed at the Edgewood Chemical Biological Center (ECBC)?**

**A.** For 85 years, ECBC's mission focused on the warfighter and will continue to do so. The warfighters' worst enemy is time, and ECBC understands that today's troops need to get to trouble spots quickly with the right equipment to support their mission. To that end, ECBC is committed to researching and developing technologies to help create an enhanced force that is deployable, survivable, and sustainable. Although ECBC's primary mission focuses on the warfighter, many of our technologies and expertise can be transferred for non-military applications and to help protect our homeland.

ECBC supports the Army vision by transitioning highly innovative technologies that span the life of the objective force. These technologies are designed to help our warfighters be the most strategic in the world. From hand-held chemical and biological (CB) agent detectors and sampling kits to flyaway forensic analysis labs to

improved gas masks, ECBC personnel are working around the clock to ensure U.S. warfighters and the nation are prepared for incidents involving Weapons of Mass Destruction (WMD).

ECBC is recognized throughout the world as a leader in CB defense. Since September 11th, ECBC's expertise has been called upon by nearly every federal agency and by several private organizations and businesses. ECBC has helped by getting U.S. Armed Forces ready to fight and win in Afghanistan, reducing the vulnerability of our chemical stockpile, and enhancing our homeland defense capabilities. With more than eight decades of CB defense experience, ECBC is a one-of-a-kind natural resource.

**Q. What do you feel are the most important challenges in preparing our soldiers and the nation for incidents involving Weapons of Mass Destruction, and what are some possible solutions to these challenges?**

**A.** Two of the biggest challenges we face today in preparing for incidents involving WMD are early detection of CB agents and having plans in place that can be followed in the event of such an incident. At ECBC, we

have a long, distinguished history of providing solutions to these types of challenges. As the challenges evolve and change, so does ECBC allowing us to address the CB defense needs of the nation.

ECBC has worked in the detection arena since its inception in 1917. Edgewood standardized the first chemical agent alarm in 1924. Today, ECBC develops a myriad of products, including chemical and biological agent detectors, sampling kits, and decontamination and protective equipment, to help warfighters be better prepared for a WMD incident.

Not only does ECBC develop cutting-edge technologies, it also is very active in training military and non-military personnel how to use the equipment and how to respond to a WMD incident. ECBC lead an effort to train more than 100 cities and thousands of first responders across the nation on how to respond to a WMD incident. Today, ECBC provides a variety of courses on CB defense for federal agencies as well as for the private sector, including first responders. These courses help military and first responder personnel identify preparedness needs in their respective communities and develop plans on how to respond to a WMD incident in their communities.



ECBC has a history of being responsive to national needs and focuses not only on the warfighter but also on national protection.

**Q. How do you see the future of Research and Development (R&D) for CB Defense changing?**

**A.** ECBC's R&D efforts for the future will remain focused on supporting the U.S. warfighter and the Department of Defense (DOD). At a minimum that support will be sustained if not increased to meet the changing needs of our country. We will also continue to support our federal and commercial customers. As we develop vital technologies, we will transfer ones that are applicable outside DOD so that others can benefit from our research and expertise.

Traditionally strong in the chemical defense arena, ECBC will continue its efforts to bring our biological capabilities up to the same level as our chemical expertise. Even before 9-11, we recognized R&D shortcomings in biodetection and bioanalysis. We continue to focus on these areas not only to support the warfighter, but also to support the nation's homeland security programs. ECBC has played and will continue to play a supporting role in counter terrorism, especially bioterrorism.

I believe one of the biggest areas the entire CB Defense R&D community will see change is in the size of our detection and sampling capabilities. We are already gradually working our way down to smaller and smaller pieces of detection and sampling equipment that not only will ease logistics but will also minimize cost. As these systems are made smaller, their operations will also

become automated allowing for a sample to be collected, processed, and analyzed with fewer steps and in much less time than our current capabilities. Another area that ECBC will be working on is early warning systems for biological agents. Because biological agent aerosols tend to be lower in concentration than disseminated chemical agents, larger samples are required. Presently, this requires relatively large equipment consuming considerable power. ECBC is researching ways to reduce the size and power requirements of these devices.

Overall, I foresee R&D related to CB defense growing tremendously in the future. This year alone, ECBC received 50 percent more R&D funds from increases in both technology base and customer funding.

**Q. What would you say to the employees at ECBC on its 85th anniversary?**

**A.** The heart of any organization is its employees. Without the talent and dedication of the workforce, ECBC would not be a worldwide leader in CB defense. The service that they are providing to the United States of America and its people is invaluable. And the fact that our people do their jobs so well that government agencies and businesses alike keep coming back to ECBC for assistance shows the caliber of people we have.

I would like to say to the ECBC workforce, thank you for your hard work and dedication over the past 85 years. Your efforts are truly appreciated. I thank you and the nation thanks you.

## CB Humor...



Private Jones quickly regretted volunteering to help provide heating and electricity for the building.



When Mrs. Smith's son finally remembered to bring his gym clothes home, she was ready.





## Biotechnology at ECBC



*Photo: Critical Reagent Repository.*

The use of biotechnology is literally as old as civilization. Beer and wine have been fermented for millions of years, bread is leavened with yeast, bacteria are used to produce cheese and yogurt, and animals are bred selectively to produce more meat and milk.

The first major advance in applying these principles in a systematic way to industrial manufacturing was in 1917, when Chaim Weizmann used a pure yeast culture to ferment cornstarch and produce acetone. Britain used acetone to manufacture explosives. Even then, biotechnology had military uses. The fermentation industry really came of age after 1945 with the production of antibiotics. All of this may be called “old” biotechnology and was essentially trial and error.

Civilization is at the dawn of the Third Revolution of the modern age and the U.S. Army Edgewood Chemical Biological Center (ECBC) is developing the people and tools needed to capitalize on this changing landscape.

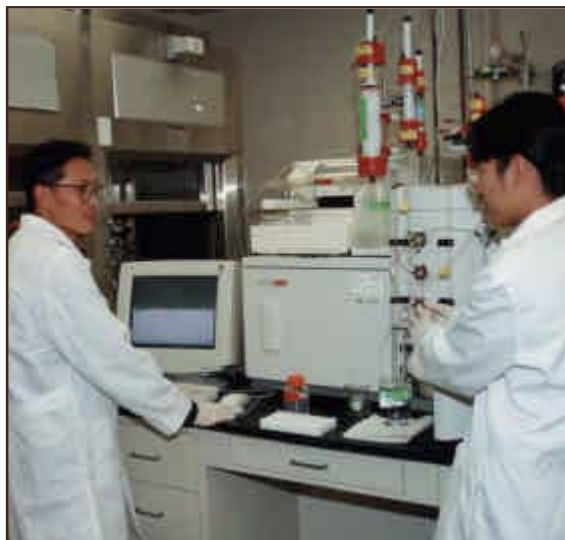
The First Revolution, known as the Industrial Revolution, radically changed society by introducing new sources of energy to manufacturing. Its single defining symbol is the steam engine. The Second Revolution began in the 1950s with the invention of the transistor and continues unabated today. Sometimes called the Information Revolution, it brought new ways of handling vast amounts of data to manufacturing and is best symbolized by the microchip. Both the Industrial and the Information Revolutions have significantly altered warfare; the implications of the latter being hotly debated by military and civilian defense planners even now.

The Third Revolution can most properly be called the Biological Revolution and traces its origin to the understanding of the DNA double helix and the subsequent development of the tools of molecular biology needed to manipulate genetic material. Developments such as DNA sequencing and cloning, DNA synthesis, and macromolecular structural analysis now allow the human race to reprogram genes in yeast and bacteria and use these cellular factories for the

manufacture of useful products. In a sense, the Biological Revolution is an extension of the Information Revolution because it allows access to the vast information stored in genes, which will allow us to radically remake the biological world. The science writer, Edward Yoxen referred to the biological world as “a vast organic Lego® kit,” and technologically advanced nations now have the ability to tailor life forms in order. More recent breakthroughs suggest the ultimate in biological control, the ability to selectively control gene expression, hence the biochemical processes required to maintain life.

Through evolution, nature, has produced a wide variety of remarkably dangerous organisms and toxins, which are lethal to humans and produce few early warning signs. Biological agents derived from these have been developed as Weapons of Mass Destruction and represent a primary strategic threat to the United States. Unlike conventional or chemical munitions, pathogenic agents such as bacteria and viruses are self-replicating (although viruses must use their host's genetic machinery),





hence very small initial quantities could be used in an attack and the effect amplified by secondary infection. These agents are easy to produce with commercially available cell culture and fermentation equipment and can be manufactured by countries and groups with relatively unsophisticated scientific capabilities.

ECBC's interest in biotechnology relates to missions involving detection of chemical and biological agents, decontamination of these agents, destruction or demilitarization of stockpiles of both chemical agents and energetic materials such as explosives and propellants, and environmental remediation.

ECBC's long-term interests include focusing on the use of genomic and proteomic arrays to address issues of low-level toxicology, biological detection and identification, and the affects of biological agents on warfighters. Toxicogenomics is a new scientific discipline that studies the effects of

toxins on genes and gene expression. Proteomics studies the production and processes of proteins, which are produced by genes.

Since the Gulf War, there has been an increased concern for exposure to very low levels of chemical warfare agents. Although such exposure may not cause immediate or obvious sickness, it may cause alterations at the molecular level that may pre-dispose a person to future ailments.

By studying the molecular consequences of low-level exposure, technologies can be developed to improve risk assessment, enhance soldier performance, and protect both the short- and long-term health of the warfighter. ECBC researchers are identifying genetic sequences that uniquely identify particular pathogens down to the species and strain level.

Since September 11th, ECBC biotechnology experts have been called upon to educate government officials on the threats of biological agents and bio-terrorism. ECBC has a full-spectrum biotechnology program with strong collaborative links to academia, the private sector, and other government agencies.

ECBC's biotechnology program includes the Department of Defense's only complete Process Engineering Facility with pilot scale biomanufacturing capability. ECBC is currently upgrading to cGMP standards, which will vastly expand ECBC's capabilities. The National Research Council has just completed a study, "Opportunities in Biotechnology for the Future Army," which describes the increasingly pivotal role that biotechnology will play in developing the future Objective Force. ECBC is committed to making those visionary recommendations a reality.



*Photo: Critical Reagent Repository.*

Recently, ECBC's biotechnology expertise was called upon by The Gillette Company to conduct a toxicology validation study. The study independently validates a new test developed by Gillette to determine the potential of a chemical to cause irritation or to damage the eye. ECBC is one of only three laboratories in the world certified to perform this study.

ECBC is partnering with Claragen, Inc., to improve production processes for recombinant human CC10 protein. CC10 is a natural human protein essential for the development of normal healthy lungs. Claragen, Inc., is developing CC10 for treatment of inflammatory, fibrotic, and immunologic diseases.

In 1998, when the toxin known as Pfiesteria was causing fish kills in Maryland waters, ECBC assisted the University of Maryland Biotechnology Institute's Center for Marine Biology with the establishment of its Biosafety Level 3 (BL3) laboratory. The BL3 laboratory was needed so that the Center for Marine Biology could conduct research with the Pfiesteria toxin. Because of the Center's inexperience with BL3 containment, ECBC was asked for assistance in helping to review engineering controls and advise on standing operating procedures and training.





## The Edgewood CB Center: “Home” of Homeland *Defense*

The events of September 11, 2001, made “homeland defense” a household phrase. With the creation of a new government office devoted to the subject, security tighter than ever before at buildings and gathering areas, and airports taking a serious stance on anti-terrorism, it seems that homeland defense is on the cover of every magazine and at the tip of everybody’s tongue.

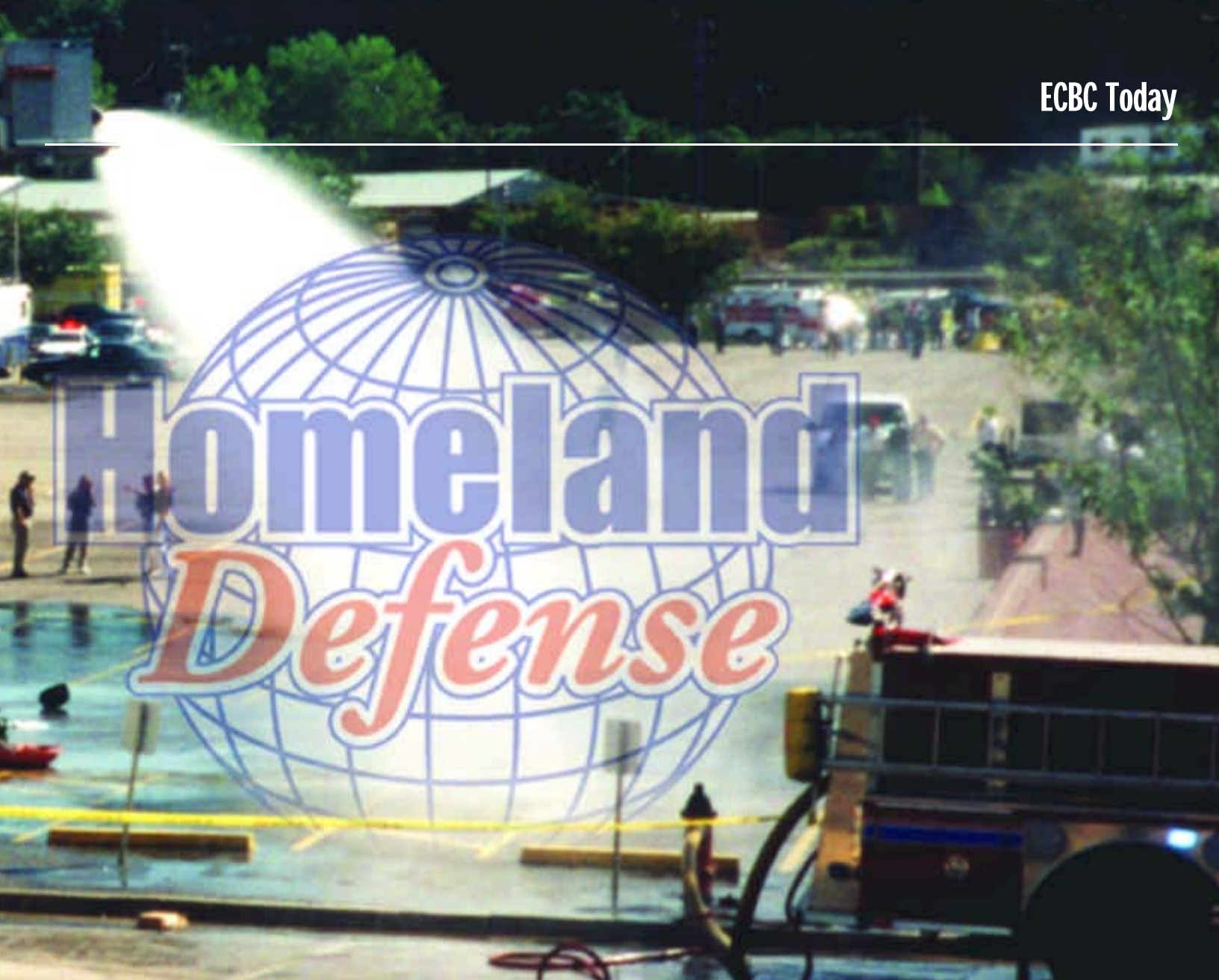
Even so, many people don’t realize that for five years prior, the Department of Defense was working to prepare communities throughout the United States to defend against incidents involving Weapons of Mass Destruction (WMD). Through a program that fostered unprecedented interagency cooperation, the Department of the Army

answered the call to duty. A Domestic Preparedness (DP) program was established at Edgewood. An innovative training system, this program delivered specialized response education to fire, police, and Emergency Management Service (EMS) personnel in the nation’s 120 largest cities. Beyond the logistical challenge of putting people and equipment where they needed to be for this nationwide training program, our organization drew upon its vast technical resources to form a foundation for the program.

With the focus of the DP program on chemical and biological detection and protection, the Edgewood Chemical Biological Center (ECBC) was a natural

choice for technical expertise. ECBC has been involved with chemical research and development since 1917, when the organization played a key role in the development of the U.S. gas mask. ECBC also has extensive experience in developing detection devices, personal protective equipment, decontamination systems, building protection systems, and equipment testing. The DP program provided an opportunity to capitalize on the varied work of ECBC researchers and engineers to support one nationwide program. With a successful program and a vice-presidential award under its belt, it can be said that the organization has “risen to the task.”





A long, distinguished stage was set for ECBC's role in domestic preparedness. ECBC has been developing the U.S. gas mask since 1920 and developed the first collective protection (filtration) systems to protect buildings and their occupants from chemical and biological agents in 1932. These filtration systems are also used in stand-alone shelters at forts and other military installations.

Over the years, ECBC maintained its position at the forefront of the field, and today offers services in training, equipment surveys, pyrotechnics, and building protection. The DP program at Edgewood transitioned to the Homeland Defense Business Unit within ECBC and continues to

support homeland security and domestic preparedness.

The Domestic Preparedness program – the flashpoint that brought ECBC to focus on homeland security – began in 1996 when Congress passed the Nunn-Lugar-Domenici legislation. This federal law provided funding for the Department of Defense to enhance the capability of federal, state, and local emergency responders in incidents involving WMD, a category that includes chemical, biological, radiological, and nuclear weapons. ECBC helped the multi-agency team achieve this objective through training, exercises, expert assistance, and an improved response program.

Introducing the program in October of 1996, ECBC trained more than 28,000 first responders in 105 communities across the country, enhancing nuclear, biological, and chemical preparedness nationwide. Between 1997 and 2000, ECBC helped to conduct more than 230 WMD exercises.

The ECBC team broke new ground in knowledge transfer, instruction techniques, and interagency cooperation by expeditiously transferring much needed nuclear, biological, and chemical defense knowledge from the Department of Defense to state and local emergency responders.

Traditional bureaucratic transfer processes were streamlined so that applicable



*Photo: DP Program Training Exercise*

knowledge was gathered, packaged, and delivered in a speedy, comprehensive manner. The DP program also cut through red tape by expediting the delivery of specialized protection, detection, and decontamination equipment to the communities.

Specifically, ECBC developed two very effective techniques to train local responders, including “team teaching.” Team teaching combined federal agency subject matter experts with local emergency responders to form credible, locally accepted instructor teams that provided students with the benefits of local knowledge and specific technical expertise. In addition, ECBC incorporated a modular structure that allowed city trainers to teach other responders after completing Domestic Preparedness course-work, allowing for a geometric growth of the initial course impact.

In support of the training, exercise, and equipment elements of the DP program, ECBC implemented an Improved Response Program (IRP). The IRP sought to improve response practices through research and real-world application of unique chemical and biological (CB) defense science and technology. Through partnering with federal, state, and local agencies, the IRP worked to increase readiness by enhancing the capability of civilian emergency responders to safely and effectively respond to potential terrorist incidents. Involving both Chemical Weapons (CW) and Biological Weapons (BW) IRPs, ECBC’s scientists established standards where no standards had previously existed. The IRPs established response templates and modified conventional response plans to take into consideration the unique consequences of a chemical or biological attack. This work impacted the training delivered by the DP program as well as the advice that would continue to be given after the fact.

ECBC recognized that there would be an ongoing need for technical assistance following the responder trainings. To that end, the DP program also involved a CB hotline, providing emergency assistance on a 24-hours-a-day, 7-days-a-week basis by linking callers to appropriate subject matter experts; a CB helpline, which provided non-emergency information on CB terrorism-related subjects to emergency responders nationwide; and an equipment testing program, evaluating commercially available CB responder equipment and providing unbiased test data to responders and manufacturers via the Internet.

The DP program as a whole altered the status quo in a number of ways. It marked a dramatic departure from “business as usual” for a government-run project by streamlining processes and eliminating red tape, to the extent that the program garnered vice-presidential attention (see sidebar). Diverse agencies came together for a common goal



with unprecedented cooperation. Training was delivered in a way that was effective, sustainable, and repeatable, allowing a multiplication of knowledge throughout the nation. Through it all, ECBC delivered outstanding technical support and guidance.

The DP Program was transitioned in 2000 and is now under the auspices of the Department of Justice. ECBC has remained actively involved in supporting the Department of Justice by developing and updating response guidebooks. In the fall of 2001, the Department of Justice recognized ECBC for its assistance in training 5,000 first responders to effectively recognize and respond to terrorist incidents involving chemical and biological agents.

A large part of the responsibility shifted to the Department of Justice; however, ECBC remained involved in the DP program by providing assistance. The Homeland Defense Business Unit was formed to market and deliver training and planning assistance to military, government, and private clients.

Based on its expertise gained through the DP Program, ECBC initiated several new programs and remains active in assisting first responder and military communities. One program is the WMD Installation Preparedness Program. ECBC identified a need to prepare military installation emergency responders against attacks using chemical, biological, radiological, and nuclear weapons. Through baseline

assessment, planning assistance, training and exercises, and technical assistance, the WMD Installation Preparedness Program provides a systematic approach to preparedness. This program was successfully piloted at two military bases.

Other programs include the Technical Assistance Team and the Improved Response Program. Between these two programs, ECBC offers a range of services, including assessing and recommending protective solutions, developing collective protection units, evaluating first responder equipment, developing rapid design solutions, developing response templates for chemical and biological incidents, and training on chemical and biological defense equipment. During the DP program, ECBC initiated a test program for first responder equipment by evaluating hundreds of commercially available detection and protective devices. ECBC continues to test commercially available equipment and provides the results of the tests to consumers so they can make better informed purchasing decisions.

Led by the same experts who were pivotal to the success of the DP program, the Homeland Defense Business Unit has worked to ensure that the progress made in technology transfer and multi-agency teamwork was not lost. ECBC is dedicated to achieving major technological advances for national defense, civilian needs, and industrial competitiveness. An important component of that work is ensuring that

innovations and best practices are able to move quickly from agency to agency and from government to the private sector.

An important component of interagency and private sector work is the organization's building protection effort. ECBC has developed collective protection filter systems to protect buildings and their occupants from chemical and biological agents. These building protection systems were installed in communities and on military installations in the United States and around the world, including Korea and Southwest Asia. As the highest level of protection available from current technology, high-efficiency filtration is a key element in any comprehensive building protection strategy. Since standardizing the first collective protection filter unit in 1932, U.S. Army engineers at ECBC have been assessing, certifying, testing, designing, and developing collective protection systems for both military and non-military customers.

Schools, hospitals, nursing homes, and various government agencies have installed collective protection systems designed by ECBC, and the Homeland Defense Business Unit provides ongoing technical assistance to building protection clients.

Many federal agencies have recognized ECBC's expertise that spans more than eight decades. As a result, ECBC is currently providing Responder Awareness and Operations courses to U.S. Coast Guard





Districts to develop an awareness of the impact of a WMD incident on maritime operations. ECBC also has been working with the U.S. Navy at installations in Japan to assist them with their WMD preparedness efforts. Additionally, ECBC's collective protection systems can be found in military facilities, government buildings, businesses, schools, and hospitals domestically and worldwide.

### Hammer Award



The Domestic Preparedness Team was recognized for its achievements by being awarded past-Vice President Al Gore's Hammer Award. This award recognizes teams of federal employees who make significant contributions in support of former President Clinton's National Performance Review principles. These principles include putting customers first, cutting red tape, empowering employees, and getting back to the basics. The Hammer Award was Gore's answer to yesterday's government and the fabled \$400 hammer. Fittingly, the award consisted of a \$6 hammer, a ribbon, and a note from Gore in an aluminum frame.



## ECBC Headliners

### **"Edgewood Invents CPR"**

The technique of mouth-to-mouth resuscitation was devised at the Chemical Research, Development, and Engineering Center (now known as the Edgewood Chemical Biological Center). The technique resulted from studies into the treatment of nerve agent victims. Previously, the method most frequently used involved applying rhythmic pressure on the back, over the lung area. While this was often successful, especially in drowning cases, it could cause collapse or obstruction of the upper airway. CPR is not only easier to apply but has a substantially higher success rate than other means of artificial respiration. Since its invention in the 1950s, CPR has saved countless lives.

### **"ECBC Clones World's First Recombinant Antibody"**

The Edgewood Chemical Biological Center (ECBC) cloned and produced the world's first recombinant antibody to detect botulinum toxin. At a cost of \$30 per milligram, this recombinant antibody is less expensive than traditional hybridoma approaches and produces a genetically defined product. Botulism is a serious illness that causes paralysis and the toxin is classified as a potential biological weapon agent. Other antibodies are currently being produced with the same technology.

### **"Edgewood Early Leader in Molecular Modeling"**

Molecular modeling and computational chemistry methods are extremely important tools in understanding chemical and biological reactions and interactions. Edgewood Chemical Biological Center (ECBC) researchers were early leaders in developing and using molecular modeling software within the Army. Commercial

molecular modeling packages were not widely available and were limited in scope. In order to address Army centric needs, ECBC developed its own molecular modeling software called the Molecular Modeling Analysis and Display System (MMADS). ECBC transferred the MMADS to over 80 academic, industrial, and government sites. As a result, the Federal Laboratory Consortium awarded ECBC the "1988 Special Award for Excellence in Technology Transfer" for the transfer of MMADS.

### **"ECBC Develops Biological Alarm System"**

The Edgewood Chemical Biological Center (ECBC) transitioned several technologies used in its Biological Attack Warning System (BAWS), the first successful real-time, lightweight biological alarm system. From 1996 to 1999, ECBC developed BAWS, which is designed to detect and warn against a biological incident before exposure. One component of the BAWS uses a high-powered, micro-ultraviolet laser that excites aerosol particles, which respond by scattering and emitting light at different wavelengths. The BAWS then analyzes the resultant scattered light for characteristics unique to biological warfare agent particles. This process takes a matter of seconds, enabling the system to instantaneously detect the presence of a hazard. Since its development, the BAWS, including various components has been transitioned to at least five other Department of Defense agencies for testing and use. Last year, the ECBC team that developed the BAWS system received a U.S. Army R&D Achievement Award.

### **"ECBC Patents Enzyme that Neutralizes Chemical Warfare Agents"**

The Edgewood Chemical Biological Center (ECBC) has patented an enzyme technology designed to neutralize chemical warfare

agents. The technology consists of neutralizing enzymes that can be added to water or any water-based application system, e.g., fire-fighting foams and sprays, aircraft de-icing solutions, aqueous degreasers or laundry detergent. In an incident where chemical agents or toxic pesticides may have been released, these enzymes can be used by first responders to quickly neutralize the chemicals before they have a chance to contaminate a wider area. The catalytic enzymes can neutralize a wide range of chemicals and should be non-toxic, non-corrosive, environmentally safe, and affordable.

### **"Non-toxic Devices for the Training of U.S. Warfighters Developed at ECBC"**

To reduce the risk to soldiers, Edgewood developed a non-toxic, environmentally friendly smoke for use during training exercises. In both the M8 TA Smoke Pot and the M83 TA Smoke Grenade, Terephthalic Acid (TA) based formulations are used as training substitutes for the hazardous Hexachloroethane (HC) formulation found in all HC Smoke Pots and Grenades. Both the M83 TA Smoke Grenade and the M8 TA Smoke Pot were Type Classified, Standard, in 1994. The M83 has been released and has been available for service use since 1997, and in February 2002, the M8 was also released.

### **"ECBC Revolutionizes Screening Grenades"**

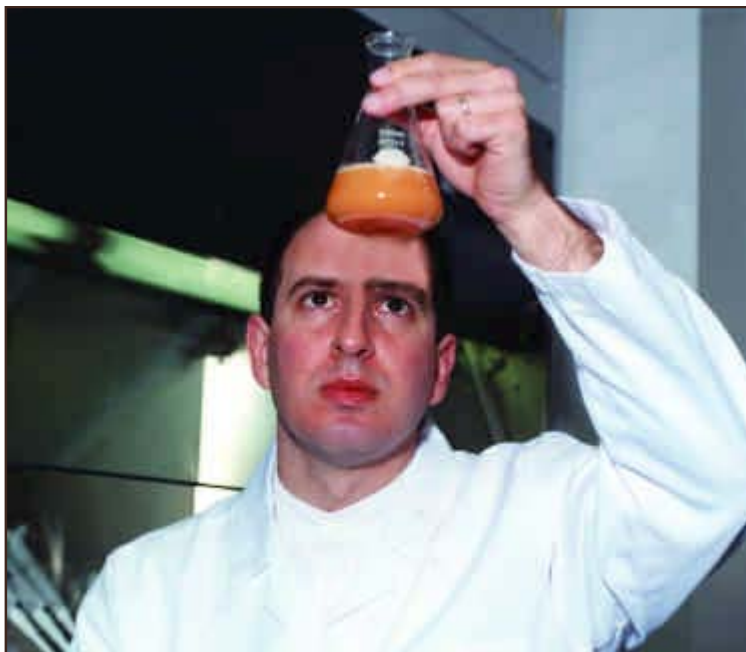
The IR Screening Grenade M76 is a revolutionary advancement in screening grenades because it obscures the visual through far infrared portions of the electromagnetic spectrum. Previous screening grenades did not have infrared capability. The M76 was type classified in 1985 and is still used by soldiers today.







## ECBC is a “Hands On” Organization



At Edgewood, our “hands on” reputation humbly began in 1917 when the United States entered into World War I (WWI), and former President Woodrow Wilson issued a proclamation that designated what is now known as the Edgewood Area of Aberdeen Proving Ground, MD, as the site for the first U.S. chemical shell filling plant. Much of the success of the Edgewood Chemical Biological Center (ECBC) over the past several decades is due to its strong “hands on” philosophy. At Edgewood, there is a team of specialists who work in the field at sites all over the United States and internationally where chemical or biological expertise is needed. This team is an integral part of all that ECBC does.

ECBC is traditionally known for its strong commitment to the research and development of CB equipment. With a solid core team of scientists and engineers, at ECBC we conceptualize, design, fabricate, test, and field products such as CB agent detectors, decontaminating solutions, and protective masks. In addition to developing and fielding new technologies, ECBC handles and tracks the chemicals and biological agents that are

used in the research conducted at the Center, and ECBC specialists go into the field to collect suspect samples, which are sent to Edgewood for analysis.

ECBC’s knowledge and expertise are also extensive in the areas of environmental compliance and pollution prevention. ECBC is very active in the clean up of formerly used defense sites, base realignment closure sites, and in the clean up of the U.S. chemical weapons stockpile.

ECBC transitions its expertise by providing consultative services to other Government agencies, academia, and the private sector. ECBC serves as an advocate on matters concerning surety, safety, physical security, health, and the environment. This knowledge and experience are integrated to ensure the lowest possible risk to ECBC workers, military forces, civilian communities, and the natural environment.

A significant contribution of ECBC’s practical expertise is in support of the Chemical Weapons Convention and the treaties between the United States and several

other countries. Since the treaties were signed in the early 1990s, ECBC has been instrumental in training United Nations’ (UN) inspectors and collecting and analyzing samples in support of chemical weapons inspections in other countries. ECBC taught United Nations’ staff how to perform inspections effectively and efficiently. ECBC hosted 50 UN inspectors for 5 days of Chemical Biological Radiological Safety and Health training. Several ECBC personnel and speakers participated in inspections in Iraq and provided an overview of facilities and inspection methods and lessons learned from their inspections.

ECBC scientists also developed and fielded a transportable, completely self-supporting modular analytical laboratory for use at treaty verification sites. This laboratory contains analytical instruments and all the support equipment necessary for the self-sufficient operation and maintenance of those instruments. This laboratory provides the “hands on” investigators the capability to analyze samples on location or to safely transport the samples when necessary.

ECBC continues to support The Office of the Assistant Secretary of Defense for Strategy and Threat Reduction that established a Cooperative Defense Initiative with Jordan, Egypt, and the six Gulf Cooperation Council nations (Saudi Arabia, Bahrain, Kuwait, UAE, Qatar, and Oman) to combat Weapons of Mass Destruction. ECBC provided support for this initiative for the testing and inspections of decontamination, detection, individual protection, and collective protection equipment. Masks, suits, boots, gloves, detectors, and packaging were visually inspected. Surveillance and fit testing were performed on the masks, and leak tests were performed on the boots and gloves. Operational capability was tested on the detectors. As a result of this evaluation, recommendations were made to improve the combat readiness of CB defense equipment.

In addition to assisting with treaty compliance, ECBC is also involved with the disposal of the U.S. chemical weapons' stockpile and the remediation of sites associated with past chemical weapons activity.

ECBC embarked on the safe removal of U.S. chemical weapons from European soil. These weapons were left from WWI and WWII. ECBC personnel conducted hazard analysis studies to assess chemical agent release scenarios that could occur while shipping chemical munitions from Germany. ECBC also provided expert counsel and technical assistance during the construction of laboratories developed to support the movement of the munitions.

In the past several years, ECBC has supported the U.S. Army Corps of Engineers in remediation activities at a number of Formerly Used Defense Sites associated with past chemical weapons activity. Projects supported by the ECBC include Operation Safe Removal in Spring Valley, Washington, DC; 5th Field Supply Depot in Mong Mong, Guam; Defense Depot in Memphis, TN; Rocky Mountain Arsenal, CO; Defense Depot Hill in Ogden, UT; and Fort McClellan, AL.

ECBC supported these projects by developing site-specific plans for monitoring of environmental media (air, water, and soil)

for agents of concern as well as their breakdown products. Risk assessment, hazard analyses, and general site safety support were also provided as part of the project planning process. Once all health and safety plans were approved, ECBC personnel were responsible for equipment mobilization and set up as well as all logistics associated with getting the site operational.

Due to the close proximity of each of these work sites to residential areas, ECBC specialists developed or improved existing procedures for the safe removal and disposal of recovered items. These procedures included setting up chemical agent monitoring and containment systems. ECBC personnel provided on-site analytical services for all samples collected during the remedial action, and ECBC's laboratory facilities also supported remediation activities. ECBC's involvement with the chemical weapons treaty and chemical weapons disposal is just one example where you will see ECBC personnel out in the field.

ECBC also supported installation restoration at sites that were not associated with chemical weapons activities. For example, ECBC helped to remediate an Army engine plant in Connecticut. The plant produced a variety of engines and aircraft components for helicopters and tanks. Over the years, soil on the plant became contaminated with a variety of materials including hazardous hydrocarbon oils. ECBC provided environmental remediation concepts that demonstrated in-situ environmental remediation of the soil by microorganisms, which are already present in the soil. The natural remediation methods demonstrated in this project resulted in substantial savings over established remediation technologies. Today, ECBC is working with a variety of organizations, providing technical support.

Currently, ECBC is providing support to the Environmental Protection Agency's Environmental Response Team. ECBC provides assistance in a variety of areas including improved CB monitoring techniques, health and safety protocol development, new technology assessments, and field assistance during emergency response operations where CB agents are known or suspected to be present

ECBC also provides support to the Department of Justice's Office for Domestic Preparedness. ECBC supports the Center for Domestic Preparedness (CDP), a federal training center that prepares first responders, emergency management officials, and state and local community leaders and managers to respond to acts of terrorism involving weapons of mass destruction (WMD) and hazardous materials. ECBC provides the CDP with technical expertise in Chemical Biological Defense and Chemical Agent Management.

ECBC plays an integral role in supporting DOJ's Chemical Ordnance Biological and Radiological Training Facility in risk management. This training facility provides responders the opportunity to train in an actual chemical agent environment, and is one-of-a-kind in the United States. It is designated a critical national asset because of its unique mission of providing state-of-the-art training to first responders who may be exposed to terrorist acts involving weapons of mass destruction. Specifically, ECBC provides expertise and assistance in the areas of chemical surety, safety, security, reliability, chemical agent application and transport, and inspection assistance.

In addition to other federal government agencies outside Department of Defense, ECBC helps to support all the military services (Army, Navy, Air Force, and Marine Corps) by helping to maintain the readiness of chemical defense equipment used by all the services. ECBC also helps by incorporating changes to CB equipment to ensure that the latest safety or environmental issues are met and to ensure compliance with new performance requirements.

Although known primarily as a research and development center, ECBC personnel can be seen all over the world applying their knowledge of CB research and development and putting technology innovations into action. Because of ECBC's "hands on" approach, its specialists better understand the needs of those in the field. This allows ECBC to stay technologically on the cutting edge and continue to provide its customers the best possible equipment, support, and expertise as it has done for the past 85 years.

## Giving Back to the Community



*Photo: Shredder Shield:  
The Edgewood Area VME  
Team designed and made  
a paper shredder shield  
for a client to lessen the  
fear of fingers entering  
shredder.*

Not only does the Edgewood Chemical Biological Center (ECBC) assist America's warfighters, its employees also actively reach out to their community and volunteer their time and expertise to help others.

ECBC personnel, along with personnel from the Center for Health Promotion and Preventive Medicine (CHPPM) help the community through the Edgewood Area Volunteers for Medical Engineering (VME). This volunteer group, located at the Edgewood Area of the Aberdeen Proving Ground, MD, helps individuals with disabilities become more independent through the use of innovative engineering.

The VME volunteers do not compete with private companies that create medical assistive devices. Instead VME focuses on designing "one-of-a-kind" devices that can be built specifically for a disabled individual that are not available from commercial sources.

Projects the volunteer team has worked on include designing and making a wheelchair backpack to allow a handicapped high school student easy access to her school

materials, and designing and making pot/pan fences for stove burners to allow one-handed cooking by a disabled client.

Organizations that this volunteer group works with include the Harford County School System, ARC of Northern Chesapeake Region, Harford County Commission on Disabilities, and the Maryland Chapter of the National Multiple Sclerosis Society. The state level VME organization is a Maryland 501(3)c non-profit organization. Team members design and make these devices on their own time, and have permission from the government to operate at the Edgewood Area.

John Staehlin, P.E., an engineer at Westinghouse Electronics in Lithicum, MD, started the state level VME program in 1978. By 1982, volunteers from Westinghouse were performing research, inventing solutions to individual challenges, and serving the needs of individuals with disabilities throughout Maryland. Other private industries in Maryland have started volunteer teams who provide their engineering talent to the VME as well.

The program at Edgewood began in 1998. This volunteer team is unique within the VME arena because it provides a "total" approach to solving the problem. Other VME teams do not generally have the diverse talents to provide both an occupational health and engineering assessment to potential clients. Edgewood Area volunteer members have a variety of backgrounds and include engineers, scientists, occupational therapists, and support personnel who volunteer their time to meet with potential clients, determine their needs, and develop innovative solutions.

The Edgewood Area VME Team was recently recognized by the ARC Northern Chesapeake Region and by Harford County Executive, James Harkins, for their efforts in the community and for their volunteer work in designing and fabricating innovative medical devices for the disabled and elderly in Harford and Cecil County communities in Maryland.



## Partners in CB Defense



Originally established to assist the United States Army prepare and respond to the threats of chemical warfare, the Edgewood Chemical Biological Center (ECBC) is an active participant of the Technology Transfer Program. In 1980, Congress passed the Stevenson-Wydler Act (Public Law 96-480). This law established technology transfer as a mission of the federal government. Many scientific advancements occur at federally-owned laboratories. These advancements are not only valuable to the government, but they are also valuable to private businesses doing similar research and development. The Stevenson-Wydler Act mandates that federal organizations, such as ECBC, actively seek the transfer of federally-funded technology and expertise to non-government entities.

In 1986, ECBC entered into its first patent licensing agreement, which transferred a blast suppression shielding technology to commercial industry. Since then, ECBC has continued to actively partner with commercial industry and academia to promote the transfer of technology and expertise between interested parties. Several

ECBC technologies that aid in chemical and biological defense were successfully transitioned to commercial industry for manufacturing. These technologies include equipment for the detection, protection, and neutralization of chemical and biological (CB) hazards.

In 1996, the Department of Defense (DOD) implemented a statute, which authorizes DOD to sell, lend, rent, or give various items or services, to include the sale of test services at laboratories or other facilities. As a result, ECBC has made available its various research facilities that can perform a variety of tests and evaluations for equipment, such as CB agent detectors and filtration units, and materials designed to protect against CB agents. ECBC can test other types of equipment not related to CB agents, including an item's response to various environmental conditions, such as heat, pressure, wind, and rain. ECBC can also test explosives, smoke, and pyrotechnics. Recently, Gillette selected ECBC scientists to perform a toxicology validation study on a new test developed by Gillette. This test is to determine the potential of a chemical to

cause eye irritation and damage. ECBC also tested first responder equipment against chemical and biological standards under Congress' Domestic Preparedness Program.

There are several ways in which commercial industry and non-DOD organizations can partner with ECBC. These include:

- Patent Licensing Agreements (PLA): An agreement in which ECBC can license its intellectual property rights to private industry for commercialization.
- Cooperative Research and Development Agreements (CRADA): An agreement that allows industry to collaborate with ECBC through the exchange of intellectual property, expertise, data, and the use of personnel, services, equipment, and facilities.
- Test Services Agreements (TSA): An agreement in which ECBC tests materials, equipment, models, computer software, and other items for another person or entity.

- Memorandum of Agreement (MOA): A memorandum that defines general areas of conditional agreement between two or more parties – what one party does depends on what the other party does (e.g., one party agrees to provide support if the other party provides the materials).

- Memorandum of Understanding (MOU): A memorandum that defines general areas of understanding between two or more parties – what each party plans to do; however, what each party does is not dependent on what the other party does (e.g., does not require reimbursement or other support from receiver).

- Support Agreement (Interagency Agreement): An agreement to provide recurring support to another DOD or non-DOD Federal activity.

Since 1986, ECBC has completed more than 200 agreements. In fiscal year 2001 alone, ECBC initiated 39 new technology transfer agreements. At the end of the fiscal year

2001, 42 technology transfer agreements were in place and active. These agreements include CRADAs, TSAs, PLA, IAAs, and MOA/MOUs. With other agreements in negotiation and new business and marketing opportunities opening up, ECBC has experienced a steady growth in its technology transfer program.

ECBC formed partnerships with several regional organizations such as the Northeast Maryland Technology Council and the State of Maryland's Technology Development Corporation to reach potential customers in Maryland and surrounding regions. ECBC works with these organizations to assist in the growth of a strong technology-based industry in Maryland. This work also provides for the enhancement of higher education programs in the local area to and above the baccalaureate level. In addition to these organizations, ECBC works with several federal government agencies such as the Department of Justice and the Federal Emergency Management Agency.

At ECBC, we continue to seek customers who have requirements that can be addressed by our core technologies, which include biotechnology and chemistry. ECBC is actively seeking partners to license several marketable patents, which include decontamination solutions and biological sampling kits. Each of these technologies has a potentially broad market with high payoffs.

Because of ECBC's history and experience in CB defense, both government and private industry alike have turned, and continue to turn, to ECBC for the latest technology and expertise. ECBC is in a position to tackle present and future CB challenges facing the nation through collaboration and cooperation with other organizations. Working together, ECBC and its partners can help to protect U.S. warfighters and citizens against CB threats while also strengthening U.S. business.

*In 1980, Congress passed the Stevenson-Wydler Act (Public Law 96-480). This law established technology transfer as a mission of the federal government. Many scientific advancements occur at federally-owned laboratories. These advancements are not only valuable to the government but also to businesses and the public. The Stevenson-Wydler Act mandates that federal organizations such as the Edgewood Chemical Biological Center actively seek the transfer of technology and expertise to non-government entities.*

## Customer Accolades

Over the years, we have received many letters and memos of satisfaction from our partners and customers, including the Assistant Secretary of Defense, the Department of Justice, Department of State, Central Intelligence Agency, Hughes Aircraft, Lockheed Martin, and the University of Maryland.

Our commitment to excellence has resulted in work with a variety of organizations and businesses that are making incredible

advances in technology. In recent years, we have had teams of our employees in cities across the United States training the first responder community how to respond to a chemical or biological (CB) incident. We have also had teams in the Hague and in Germany, supporting the On-site Inspection Agency, and in Iraq supporting United Nations' Special Commission.

Since September 11th, numerous agencies have requested ECBC's support to protect

against CB threats. We have also led efforts in the anthrax investigation and future protective measures against anthrax.

Customer surveys resulted in 85-95 percent satisfaction in the following areas: within budget, competence of personnel, meeting requirements, and delivery on time. We continue to monitor our customer satisfaction levels and strive for continuous improvement.

# State-of-the-Art Facilities Keep ECBC on the Cutting Edge in CB Defense Research

ECBC has more than 25 of the most advanced chemical and biological research facilities in the United States, as well as the latest in computer-aided design and engineering. These facilities and the experts who work in them keep the Center at the forefront of CB defense research. To stay at the forefront, ECBC strives to keep its laboratories, chambers, computer systems, and fabrication facilities up-to-date and campaigns for construction of new facilities when needed.

### Facilities

Administrative	279,932 sq ft
Laboratory	869,471 sq ft
Storage	282,589 sq ft
Other	102,178 sq ft
<b>Total</b>	<b>1,534,170 sq ft</b>

### Unique Facilities

Berger Lab Complex (high bays, chem labs, engineering labs and admin)  
BL3 Suite  
CB Forensic Analytical Center  
Chemical Transfer Facility  
Critical Reagent Repository  
Design Evaluation Lab  
Electro-Optics Lab  
Environmental and Field Testing Facilities  
Experimental Aerodynamics  
Experimental Fabrication Facility  
Hazardous Materiel Testing Facilities  
Individual Protection Equipment Lab  
McNamara Life Sciences Research Lab  
Microscopy and Microanalysis Facility  
Process Engineering Facility  
Protection Factor Facility  
Pyrotechnics Development Complex  
Quality Evaluation Laboratory  
Rapid Design and Prototype Laboratory  
Respirator Prototyping Lab  
Rubber Lab  
Smoke Breeze Tunnel  
Special Containment Facilities  
Radiation Laboratory



### Bernard McNamara Life Sciences Research Facility

In 1997, ECBC built the Bernard McNamara Life Sciences Research Facility, a modern facility for cutting-edge research. It is a sign of vitality and growth in the scientific underpinning of our national defense.

Constructed at a cost of over \$30 million (with almost 120,000 square feet of lab and administrative space), it is designed for state-of-the-art research and toxicological testing. It supports our leadership position in animal welfare and meets state, federal, and Army environmental regulations for the contain-

ment and discharge of hazardous materials. This major Army construction project provides ECBC with a secure facility to perform life-science studies in compliance with the safety, security, and surety requirements of the regulatory agencies.

A three-story building located adjacent to existing research facilities, it contains shipping and receiving docks, mechanical and utility rooms, and electronics and necropsy labs. The second floor consists of a percutaneous suite, subchronic and acute inhalation suites, an electrophysiology lab, and a Biosafety Level 3 (BL3) microbiology suite. The third floor contains analytical or





*Photo:  
Dr. Bernard P.  
McNamara.*

the largest of its type and has state-of-the-art capabilities in the areas of isolation, identification, preparation, characterization, and testing of bacterial, viral, and fungal microorganisms. The facility, including BL2 and BL3 labs, enhances military biological capabilities. At the same time, we can support research and development needs of the private sector.

Life Science researchers in the McNamara Building are responsible for planning, performing, and consulting on basic and applied research for chemical and biological defense materials in the areas of environmental science, pharmacology, toxicology, microbiology, biotechnology, and related life sciences as well as research and application of alternatives to animal testing. Investigators can assess the hazards associated with chemical-based military items in this facility or identify the microbiological contents of samples collected from on-site investigations. Results of these analyses (low-level chemical agent inhalation studies and biological agent identification testing) will provide invaluable information on risks to (1) soldiers during training or while in the field, (2) manufacturers, (3) depot handlers, (4) the environment, and (5) the nation and local communities. ECBC Life Science researchers also provide management of veterinary health and animal husbandry programs and policies, including facility and equipment upgrades, and serve as expert consultants on animal use issues for the Institutional Animal Care and Use Committee (IACUC).

The building is dedicated to Dr. Bernard P. McNamara, who was a career civil servant in the former Chemical Systems Laboratory at Edgewood. Born in Baltimore in 1915, Dr. McNamara obtained his Doctorate in Pharmacology from the University of Maryland in 1942 at the age of 27, a mere 10 years after graduating from high school. This dedication to work would typify his contributions and accomplishments at Edgewood throughout his career. It was his dream to gather all ECBC life scientists into one facility.

Dr. McNamara was widely respected for his scientific contributions, many of which were still being built upon as basic research in the field years after his death in 1980. Author or co-author of more than 150 scientific publications, he served on a variety of prestigious national and international committees, working with such agencies as the National Cancer Institute, the U.S. Environmental Protection Agency, the Mutual Weapons and Development Exchange Program, and the Committee on Disarmament. In this latter capacity, he attended sessions of the Strategic Arms Limitations Talks (SALT) as a technical delegate. His participation in such interagency and interface activities contributed greatly to the establishment of national policies in the performance of toxicological testing and research.

clinical chemistry, physiology, enzymology, teratology, biochemistry, microbiology, pathology, molecular and cellular biology, electrophysiology, and aquatic toxicology labs as well as a surgical suite. Extensive engineering controls are designed into the facility to ensure worker safety and provide a clean environment. All labs are under negative pressure (to contain hazardous materials) and all gases are processed through redundant filter systems.

In 2001, new microbiological labs for work with human, animal, and vegetable pathogens requiring high containment levels became operational. The facility is among

## Biosafety Level 3 (BL3) Laboratory

ECBC is proud to announce its BL3 facility was inaugurated in September 2001. The BL3 lab has several unique qualities, including a high surety level and integration with a variety of biological and chemical research capabilities. The BL3 will allow cutting-edge Army research on pathogens of military interest, leaving enough installed capability to perform work for other government agencies or private companies.

Recently, the BL3 team established several new technologies for microbial detection and identification. These technologies have helped the team test sample contaminants from the Capitol, New Jersey, and New York regions in support of the national emergency response to terrorism threats.

# The Process Engineering Facility

The Edgewood Chemical Biological Center's (ECBC) Process Engineering Facility (PEF) is a 20,000 square foot research and development facility, which has extensive capabilities to produce enzymes, antibodies, and other cellular products. The PEF, with its highly trained, multi-disciplinary team of scientists, is capable of providing cradle-to-grave project support. This includes basic molecular biology and gene cloning to scale-up bioprocess design, validation, and optimization for improved product quality and cost savings. Scientists at ECBC have extensive experience in performing a complete array of bioanalytical procedures (e.g., immunoassay, fluorescence microscopy, electrophoresis, and spectroscopy).

The PEF possesses state-of-the-art equipment to perform scale-up production and optimization studies using hollow-fiber bioreactors, stirred reactor fermentors,

downstream purification, and final product milling/drying/preservation. In addition to basic research and development bioprocess engineering, the PEF can also perform customer-designed batch production runs for material required in initial product testing and evaluation.

The PEF recently marked the opening of the Critical Reagent Repository (CRR). Funded by the Joint Program Office for Biodefense, the CRR stores and validates all immunological and DNA-based reagents for the Department of Defense. The facility includes three fail-safe liquid nitrogen freezers capable of storing more than 75,000 samples, a 1,500-gallon liquid nitrogen tank for supplying uninterrupted coolant, an archiving database with secure "Swiss vault" capability, remote monitoring, a back-up generator, and secured access.

The PEF is in the process of being upgraded to full compliance with the Food and Drug Administration's (FDA) guidelines for current Good Manufacturing Practices (cGMP). Specifically, the upgrade will allow the production of fermentation and cell culture products that meet cGMP standards, which are the latest standards set by the FDA for products intended for human use or diagnostic processes.

The facility's capabilities will be available to small biotechnology companies that do not have the capability to produce biomaterial that meet the FDA's human use standards. Compliance with cGMP requirements allows the PEF to manufacture human use and diagnostic products for Phase I and II clinical trials, which are the first steps in testing new medicines in humans. The facility is expected to be upgraded in 2002.

# Computer-Aided Design and Engineering

The Computer-Aided Design/Engineering (CAD/CAE) facility, operated by a highly skilled team, provides customers with design, analysis, and prototyping services using state-of-the-art equipment and sound engineering principles. The facility maintains the latest technologies and qualified personnel to execute complex projects covering all aspects of mechanical and interdisciplinary design. Fully integrated with the Experimental Fabrication (XFAB) shops, the team provides rapid response concept-to-product total solutions. They also supply virtual prototyping, rapid prototyping, small-scale production, and much more.

The CAE Team uses sophisticated 3-D scanning hardware and software to rapidly generate CAD models from existing items. By evaluating production possibilities and design issues, engineers can help manufacturers avoid development

limitations and reduce development time as well as production costs. Advanced rapid prototyping and Computer-Aided Manufacturing (CAM) technologies allow the team to go directly from the computer screen to an actual working model. A multi-faceted analysis service can conduct several types of examinations including static, dynamic, thermal stress, kinematic motion, and tolerance. In addition, "Virtual Prototypes" can be created to visualize models and assemblies prior to fabrication.

At the CAE facilities, the CAE Team acts as a service bureau to support product teams in the Armed Forces and private industry. CAE is heavily relied upon and particularly active in times of international conflict, such as during Operation Desert Shield/Storm. Customers are provided with engineering designs, drafting, and engineering prototypes. The team supports military missions by developing products needed on

short notice. In the commercial arena, manufacturers can take advantage of this capability to have models designed and prototyped with very rapid cycle time. CAE specialists can predict product attributes early in the development process and recommend the most appropriate design, layout, and production choices. After analyzing an existing model, engineers can help to ascertain and correct problems. The CAE facilities will help manufacturers develop products more cheaply by determining and recommending the most economical design.

One of the added benefits of CAD solid modeling is the ability to render or visualize the models and assemblies in a photorealistic perspective. These virtual prototypes can be dynamically rotated, measured, plotted, and electronically distributed for thorough evaluation before physical parts are created.

## Dr. Bernard Berger LABORATORY COMPLEX



In 1989, ECBC added the Berger Laboratory Complex to its growing list of state-of-the-art facilities. The laboratory provides significantly increased capabilities for defensive development work.

Planning for this facility began in the late 1970s, and construction of the \$23 million, 137,000-square-foot facility was completed in 1989. The facility consists of three interconnected buildings, each with its own functional purpose in carrying out research, development, and engineering for chemical defense. The building includes a 98-seat auditorium with the latest audiovisual equipment for conferences, seminars, and in-house briefings.

In addition, the facility includes a testing area, consisting of five bays that are up to two stories high. These test bays are specifically designed so that a typical combat vehicle can be driven in for any functional

testing. The bays are also equipped with movable and detachable engine exhaust hoses and rooftop ventilators.

The facility was named after Dr. Bernard Berger, who for over 37 years, played a leading part in directing the development for the United States' position and work in chemical defense as an Army civilian chemist.

Born in New York on July 9, 1915, Dr. Berger received a Bachelor of Arts in chemistry from Catawba College. He then obtained his doctorate in organic chemistry from the University of North Carolina at Chapel Hill.

In 1942, Dr. Berger began his illustrious federal career as a chemist at Edgewood Arsenal. During his years of service, he received several awards including the Commendation for Meritorious Civilian

Service from the War Department for his research in protective clothing and the Meritorious Civilian Service Medal, the second highest civilian employee award from the Secretary of the Army.

By 1963, Berger was the director of Weapon Systems for the Chemical Research and Development Laboratories located at Edgewood; and in 1966, he was appointed Deputy Director of the new Weapons Development and Engineering Laboratory. In 1971, he took the position of Deputy Director of the new Development and Engineering Directorate where he once again was awarded the Meritorious Civilian Service Medal.

Dr. Bernard Berger passed away on February 23, 1981, a little less than a year after his retirement from years of dedicated Federal service.



# Advanced Chemistry Laboratory To Become A Reality

**Designed for modern chemistry,  
state-of-the-art equipment will be  
able to analyze at the parts  
per billion level**

The Edgewood Chemical Biological Center (ECBC), in staying on the cutting edge of chemical and biological research, is in the process of designing and constructing a new advanced chemistry laboratory at the Edgewood Area of Aberdeen Proving Ground, MD. The new laboratory is part of the fiscal year 2002 defense budget and will ensure continuation of efforts to counter the evolving threat of chemical warfare and the use of chemical and biological agents by terrorists.

ECBC is a unique national asset that has been the focus of research and development work involving super-toxic and lethal chemical agents in the defense against chemical weapons for more than 80 years. The overarching goals of the facility are to consolidate and modernize a number of disparate operations, originally developed to address offensive chemical weapons programs. The facility will also address a new threat – defending against battlefield- and terrorist-use of chemical weapons. Another goal of this facility is to help foster interaction and collaboration between ECBC scientists by consolidating their location.

The new Advanced Chemistry Laboratory will replace the existing chemistry facility, known as the Amos Fries Building. When the Fries building was constructed in 1963, it was specially designed for advanced studies of chemical compounds and materials to increase the Army's chemical defense research capabilities. It was unique at that time because it included several safety features such as individual air intakes and air exhaust systems for each laboratory. The exhaust hoods connect to filtration systems that filter out airborne chemical materials before the air is released into the environment. In the 1960s, these safety features were revolutionary and not yet required by environmental protection laws.

The Fries Building cost \$3 million to build. Now, after almost 40 years of use, it is beyond practical upgrade. The estimated cost to replace the existing building with the new Advanced Chemistry Laboratory is approximately \$40 million.

The new Advanced Chemistry Laboratory, designed for "modern chemistry," will be highly instrumented and able to analyze

at the parts-per-billion level. It will be designed for flexibility so that it can adapt and address the needs of future scientific advancements. Safety in the new laboratory is also a primary consideration.

Engineering controls will protect scientists in the laboratories as well as in the environment. Each laboratory will have its own air intakes and air exhaust system. Filtration systems will filter out any airborne chemicals before the air is released outside the building. These features will go beyond what is required for this type of facility and will cost almost one-third of the estimated price for the entire facility.

The new building will have two distinct sections, laboratory area, which will consist of approximately 54,000 square feet of lab space and an administration and lab support area at approximately 20,000 square feet. The administration and lab support area will be where scientists sit when they are not required in the labs, and will be a secure workspace for classified materials. This will increase public access to the scientists. However, access to the laboratory area will

*// The Advanced Chemistry Laboratory will be the first ECBC facility built in the new millennium. The various laboratories within the facility will be modular so they can be reconfigured and adapted to address new missions and meet new challenges in chemical warfare research. //*

be very limited. By using more modern and energy efficient building systems, there is an estimated savings of \$300,000 to \$500,000 per year in utility costs. Savings like these will result in lower, more predictable costs to customers.

A central feature of the laboratory will be the Nuclear Magnetic Resonance (NMR) suites. NMR is a critical tool for all chemistry because it helps scientists identify the molecular structure of chemicals. The suites will consolidate eight NMRs into four suites, each suite containing two NMRs of varying field strengths. By combining the NMRs, ECBC will increase their use and availability to researchers. The NMRs provide support to areas such as decontamination, carbon studies, and sample analysis in support of the Chemical Weapons Convention treaty.

Under the Chemical Weapons Convention treaty, each signing country is allowed to have one "single small scale facility (SSSF)" for manufacturing chemical agents in small quantities for the development of defensive measures. ECBC is the United States' SSSF and this capability will be part of the new chemistry laboratory. Once the disposal of the U.S. chemical weapons stockpile is complete, ECBC's SSSF will be the only national source for research and development quantities of chemical agent. For the past

year, ECBC staff has worked with an architecture and engineering team from Michael Baker Associates and DRS Architects on the development and concept design for the facility. The U.S. Army Garrison-Aberdeen Proving Ground and the U.S. Army Corps of Engineers have also been actively working with ECBC on the development of this project.

The new laboratory is expected to be operational in the Fall of 2005. In addition to the Department of Defense, the new laboratory will support several federal agencies including the intelligence community, Federal Bureau of Investigation, Department of Justice, Department of State, and fielded and future Chemical Biological Defense needs.

The Advanced Chemistry Laboratory will be one of several facilities that ECBC operates. ECBC has modernized several of its facilities over the years to meet the challenges of the future. In addition to constructing a new chemistry facility, ECBC has already built cutting-edge engineering and life sciences research facilities. These facilities provide the cornerstone for the vital work that ECBC does to protect U.S. warfighters and citizens from the threats of chemical and biological agents.

## Amos A. Fries

The new Advanced Chemistry Laboratory will replace the Amos A. Fries Chemistry Building built in 1963. The Fries building was named after Major General Fries, who was born in Vernon County, WI, in 1873.

Fries graduated from West Point in 1898 and then served as lieutenant colonel in the Army Corps of Engineers. In 1917, he was appointed Chief of the Gas Service, American Expeditionary Forces (AEF), a position he held during World War I. Fries organized America's first Gas Service as part of the AEF in France and directed its activities through the 1918 campaigns, the only occasion in U.S. history when the Army participated in full-scale chemical warfare.

After the war, Fries became the Commanding Officer of Edgewood Arsenal in 1919. He led the struggle to make the Chemical Warfare Service (CWS) a permanent part of the post-war Regular Army. He worked closely with Congress; and in 1920, the CWS was made permanent. Throughout his career, Fries worked tirelessly to advance the Army's chemical training and to preserve the CWS as a permanent organization. Fries retired as a major general in 1929 and died in 1963.

Fries published his first book, **Chemical Warfare**, in 1921, co-authored with Clarence J. West. This work is still used today as a reference source. His awards included the Distinguished Service Medal, Commander of the Legion of Honor (France), and the Cross of St. Michael and St. George (British).

Fries' early work with chemical warfare made him the first choice in naming the Amos A. Fries chemistry laboratory. When the laboratory was built, it was considered state-of-the-art and was specially designed for advanced studies of chemistry to increase the Army's chemical defense research capabilities. The new advanced chemistry laboratory is a symbol of the dedication that Fries had in making defensive chemistry research a permanent part of Edgewood and exemplifies how far this work has come in 85 years.







The tragic events of September 11th awoke the United States to the realities of terrorism in our world and the vulnerabilities of our nation. At the same time, it showed the determination, skill, and courage of the nation in the face of a tragedy of such great magnitude. From the firefighters and police officers who were first on the scene and the National Guard troops who took the terrible duty of standing watch in the days and months following, to the whole host of federal, state, and local government agencies who rose to the challenges and beyond, the United States proved to the world and itself how resilient and responsive it can be.

At the Edgewood Chemical Biological Center (ECBC), our staff were among the many who found themselves swept up in responding in the aftermath of the 9-11 attacks. For the last 85 years, ECBC has prepared U.S. warfighters for incidents involving Weapons of Mass Destruction (WMD), focusing on chemical and biological (CB) agents. Since its inception during World War I, the organization developed equipment such as protective masks, detectors, and sampling kits for use by U.S. warfighters. Several years ago, ECBC expanded the scope of its mission from the military to the private sector. Today, some of these vital technologies are being transitioned to commercial industry so that U.S. citizens can benefit as well. ECBC also trains first responders how to respond to WMD incidents and provides independent testing of commercial CB equipment.

ECBC's background and expertise make it a popular source for technology solutions, training, and advice in the wake of 9-11. ECBC has a large support role in the U.S. war on terrorism. ECBC technologies are helping to protect critical sites across the country, and many businesses and government agencies have approached the Center to request equipment testing, field training, and support from ECBC personnel. With this extensive "hands on" capability, ECBC is helping to protect both U.S. warfighters and our homeland.



### Technology Solutions

Immediately following the attacks on September 11th, federal intelligence agencies deployed mobile forensic laboratories and sampling kits developed at ECBC to the Pentagon, the crash site of United Airlines Flight 93 in Somerset, PA, and New York City. Mobile laboratory shelters, also developed at ECBC, were sent to the landfill on Staten Island, where evidence was being sorted and processed. Additional laboratories developed for biological analysis were deployed to Florida and assisted with the analysis of anthrax samples.

A number of years prior to the events of 9-11, ECBC had developed mobile or "flyaway" laboratories. The flyaway or modular laboratory was originally designed to support the multilateral Chemical Weapons Convention, the Bilateral Destruction Agreement, and the Wyoming Memorandum of Understanding. All of these treaties include provisions for sampling and analysis to verify compliance. This requirement created a need for an on-site analytical capability during Chemical Weapons Inspections.

These modules contain analytical instruments; in this case, a Gas Chromatograph/Flame Photometric/Mass Selective Detector, a chemical fume hood, and all the support equipment necessary for the operation and maintenance of those instruments. The modules can be transported on passenger aircraft and are designed to minimize connections and on-site laboratory set-up time. The modules also provide work platforms for the instrument in situations where bench space is not provided. The system is adaptable and can be expanded to include other analytical systems, as on-site laboratory needs change.

Other ECBC technologies supporting the war on terrorism include a biological detection system currently deployed around high security sites across the country, biological sampling kits, and bio detection kits used in screening buildings for biological agents.

### Testing



Since 9-11, ECBC's ability to test commercial CB protective equipment has been highly sought after. A key facility to this testing is the Protection Factor Facility. This facility is designed to evaluate the performance of new respirators and chemical protective clothing ensembles. ECBC has seen an increased demand for its personnel's expertise in setting up protocols and performing fit factor testing with its high tech systems and chambers. In this facility, we conduct physiological testing to evaluate an individual's ability to perform a wide range of activities, while wearing various forms of protection against CB agents.

Through formal agreements, ECBC tests technologies and equipment at its facilities for other government agencies and private industry. ECBC supported one customer by testing biological agent detection devices in a simulated mailroom. ECBC also tested technologies designed to kill anthrax spores. For another customer, ECBC tested 13 commercially available masks to determine their effectiveness against CB agents. Although ECBC cannot endorse any commercially available products, we can provide valuable unbiased test data so that our customers can make informed decisions.

### Technical Expertise

ECBC's real expertise is found in its employees. The "hardware" and data currently playing a vital role in the war on terrorism would not be possible without the highly skilled ECBC staff. Since 9-11, ECBC employees have risen to the call, providing facilities for testing, research, development on site at Edgewood, MD, and travel inside and outside the country, providing expert advice and training in the field.

ECBC provided technical advice and consultative services to a number of federal, state, and local agencies. ECBC personnel can assess the adequacy of existing building protection and the vulnerability of buildings.

Some of ECBC's most notable customers include the Federal Aviation Administration, National Security Agency, and the New York City Transit Authority. In addition to conducting assessments, ECBC's experts in homeland defense developed courses and held several training sessions and briefings on topics such as basics of WMD, WMD first responder awareness and operations, WMD preparedness, and community preparedness. ECBC supported several organizations and individual customers by providing information on WMD. These customers include federal judges, airports, military installations, state health departments, medical



centers and hospitals, local schools, and local hazardous materials response teams. ECBC personnel even supported the U.S. Embassy in Poland by helping to train civilian and military physicians on CB agents. Although we at ECBC provide "hands on" support to the war on terrorism, we also respond to many inquiries and questions through telephone calls and e-mail.

## Partnering

Since 9-11, numerous organizations have requested formal partnering agreements. ECBC entered into several homeland defense-related Cooperative Research and Development Agreements with prestigious companies such as Lockheed Martin and Universe Technologies. These agreements allow ECBC and the company to exchange information and intellectual property in order to create technologies and procedures to enhance domestic preparedness and public safety. In addition, ECBC has entered into several Testing Service Agreements, which enable companies to have their products tested at ECBC by our experts. ECBC is currently testing CB protective masks, clothing, and detectors.



## Edgewood CB Center Provides Support to U.S. Olympics

Edgewood CB Center personnel and equipment helped to support the Federal Bureau of Investigation (FBI) and emergency planners at this year's Winter Olympic Games in Salt Lake City, UT.

Four ECBC personnel were on-site in Utah during the Olympics to provide technical assistance to the FBI's Hazardous Materials Response Unit. This support involved on-site scientific expertise in both biological and chemical forensic analysis, operation of and support to biological and chemical analytical systems, and the potential for on-site analysis of samples if the need arose.

The analytical instrumentation used at Salt Lake City is part of the FBI's flyaway laboratory that was designed and developed under contract at ECBC's Chemical Biological Forensic Analytical Center. ECBC personnel also delivered a new system to the FBI that can analyze trace quantities of explosives. The system, designed and developed by ECBC, is vehicle and trailer mounted and is self supporting. ECBC helped the FBI perform initial testing of the system.



In addition to the on-site technical support to the FBI, ECBC also supported emergency planners at the Olympics. The Responder Assets Management System (RAMS) and its newest version RAMSAFE™ were used during the Olympic Games. RAMSAFE™ was deployed to Salt Lake City, where over 100 federal, state, and local law enforcement officials from 20 different agencies received RAMSAFE™ training.

RAMSAFE™ is a breakthrough emergency preparedness software that can improve national security by reducing human loss and economic loss from bioterrorism by as much as 50 percent in affected U.S. cities or other locations. RAMSAFE™ also dramatically improves disaster preparedness for other types of disasters, including man-made, accidental, or acts of nature, which threaten national security. RAMSAFE™ was developed jointly by ECBC and Oak Ridge National Laboratories under the Domestic Preparedness Program and has been licensed to Public Safety Systems (PSS), PLL for commercialization.



# NBC Industry Group

The NBC Industry Group is composed of about 100 companies, not-for-profit organizations, and consultants who support nuclear, chemical, and biological warfare defense activities. In addition to military defense against chemical and biological warfare, interests of the Group encompass domestic preparedness against chemical and biological terrorism as well as the Chemical Weapons Convention and other treaties

## NBC Group Members

3M  
Agilent Technologies  
Air Techniques International  
AMH Consulting  
Applied Physics Lab  
Argon Electronics  
Arthur D. Little, Inc.  
BAE SYSTEMS  
Battelle Memorial Institute  
Bill Richardson  
Block Engineering  
Booz-Allen & Hamilton, Inc.  
Braddock Smith Group  
BRUHN NewTech, Inc.  
Bruker Daltonics  
BSM, Inc.  
CBIAC  
CDI Services, Inc.  
CDS Analytical  
CEPHEID  
Chemical Agent Monitoring Supply Company  
CLR Photonics, Inc.  
CMS Corporation  
Colclasure Consulting  
Coleman Research Corporation  
Commonwealth Biotechnologies, Inc.  
Communications-Applied Technology Co., Inc.  
Constellation Technology Corporation  
CRE  
C. Tucker Battle, Consulting  
Defense Group, Inc.  
Draeger Safety, Inc.  
Dycor Industrial Research LTD  
DynMeridian  
Eagle Support Services Corporation  
EAI  
Echo Technologies  
EDO Corporation  
Engineered Support Systems, Inc.  
EnviroNics USA  
ETG, Inc.  
Fluor Federal Services  
FIBERTEK, Inc.  
General Dynamics  
Gentex Corporation  
GEO-CENTERS, Inc.  
GEOMET Technologies, Inc.  
Graseby Dynamics  
Guardian Mfg. Co.  
Guild Associates, Inc.  
Horne Engineering Services  
Horton Consulting  
ICF Consulting  
Idaho Technology Inc.  
IIT Research Institute  
ILC Dover, Inc.  
IMR Group  
INFICON, Inc.  
Innovative Emergency Management, Inc.  
Intellitac  
Interspiro, Inc.  
IronPride Consultants, Ltd.  
ISEA  
ITT Industries  
Jaycor, Inc.  
JGW International, Ltd.  
Kappler Protective Apparel & Fabrics  
Laser Consultants, Inc.  
Lockheed Martin  
Los Alamos Technical Associates  
Meridian Medical Technologies, Inc.  
Meso Systems Technology, Inc.  
Mevatec Corporation  
Microsensor Systems, Inc.  
Midwest Research Institute  
MSA Defense Products  
Nanoscale Materials, Inc.  
New World Associates  
Northrop Grumman Life Support  
Northrop Grumman Information Technology  
Northrop Grumman Integrated Systems  
OptiMetrics, Inc.  
Orbital  
Physitron, Inc.  
Public Safety Group  
Radian, Inc.  
Raytheon Technical Services  
The Reeves Group  
Research International, Inc.  
RTI  
SAIC  
Scenczar Corporation  
Scitech Services Inc.  
Science and Technology Corporation  
Scott Health and Safety  
SENTEL  
Southern Research Institute  
SRD Corporation  
SRI International  
System Planning Corporation  
TDA Research, Inc.  
Technology Marketing  
Tex-Shield, Inc.  
The Centech Group  
Titan Systems Corporation  
Tradeways, Ltd.  
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TRW  
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TVI Corporation  
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# NBC Industry Group

*An association of organizations  
supporting nuclear, biological,  
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February 18, 2002

## CONGRATULATIONS TO THE EDGEWOOD CHEMICAL BIOLOGICAL CENTER ON ITS 85th ANNIVERSARY!

The NBC Industry Group Board wishes to congratulate ECBC on reaching its 85th year of accomplishing CB defense research and development efforts.

Each of our member companies recognizes the dedicated and excellent work that ECBC has performed for these many decades - in fact, most of our member companies have toiled alongside ECBC during at least some portion of those years. We salute ECBC - not only for its longevity, but also for its many, many contributions to national defense.



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For more information about  
Edgewood Chemical Biological Center

check out our Web site at:

<http://www.sbccom.army.mil>

or

email to [technical.outreach@sbccom.apgea.army.mil](mailto:technical.outreach@sbccom.apgea.army.mil)



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